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ABSTRACT

This document consists of the five consecutive issues of the journal "Imagine..." published during volume year 4. Typical journal articles cover teaching academically talented secondary students in the following focus areas: (1) planning ahead for college; (2) history and archaeology; (3) physics and astronomy; (4) the global society; and (5) computer technology. Many articles were written by students. In addition to articles, each issue includes special program announcements, competitions, book reviews, a college review, and puzzles. Sample articles include: "Everything You Ever Wanted To Know...Interview with a College Admissions Director" (Susan Hellerman); "Going Public: The Powerful Pluses of Undergraduate Education at State Institutions" (Lesley Mackay); "In Retrospect: How We Got the Most Out of Campus Visits" (Robert Suderman and Tamara Suderman); "Interview with Eric Gordon: Art Conservator" (Lesley Mackay); "National History Day: Promoting the Study of History in the Schools" (Robert James Warren); "Potsherds and Emeralds: Portrait of a Young Archaeologist" (Lisa Brody); "From Jawbones to Genomes: The History of a Science" (Scott Rifkin); "Making the Most of a Museum Internship" (Amanda Bell, Shelli Calland); "Hooked on Physics: Seven Astrophysicists Share Their Stories"; "KidSat: Students Exploring Earth from Space" (Mark Jones and Lesley Mackay); "Spending a Summer in Aerospace Engineering" (Jonah Berger and Amelia Dudley); "Exploring Career Options: Planetary Science" (Carol Blackburn); "Craig Kielburger and Free the Children: Protecting Young People's Rights" (Lesley Mackay); "Traveling the World...To Promote Understanding" (Diana Rutowski and Bill Loth); "Model U.N.: Debating World Issues...and More" (Brian Milch and Jessie Withrow); "Cycles of Destruction" (Shaumo Sadhukhan); "Panning for Gold on the World Wide Web" (Carol Blackburn); "Create Your Own Web Page: Getting Started" (Eileen Ptak); "ThinkQuest: Teaching and Learning, Internet-Style" (Carol Blackburn); and "A Portrait of the Programmer as a Young Man" (Joseph Turian). (DB)

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IMAGINE

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VOLUME 4

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VOLUME [illegible] • NUMBER 1

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Spotlight On

PLANNING AHEAD FOR COLLEGE

One way to preview campus life is by taking a summer course at a college or university. Here, CTYers relax between classes at Johns Hopkins.

Photo by Steven Hale

Selecting a college is a major life decision, too important to be left to the last minute. The earlier you start and the better prepared you are, the more fulfilling and satisfying your eventual decision will be.

This issue of *Imagine* offers insight and advice about the college admissions/selection process from many viewpoints: we hear from a college admissions director, an independent educational consultant, a parent who's been through it with two daughters, a recent high school graduate, and a recent college graduate. And in addition to discussing Caltech in our on-going college review series, we also explore the benefits of public undergraduate institutions.

If you're one of our younger readers, you may assume at first glance that this topic isn't all that relevant to you. But it's never too early to start thinking about college. In a sense, *Imagine* focuses on planning ahead for college in every issue: we describe academic opportunities, enrichment activities, and supplemental experiences that will help you develop into a successful college applicant who will get the most out of an undergraduate education.

If you're one of our older readers already in the throes of choosing a college, consider this issue's advice on narrowing your choices and making a final selection. Remember: Wherever you go, what you get out of college will depend primarily on what *you* put into it.

IAAY

MARK YOUR CALENDAR

with these October-December registration deadlines for selected academic competitions. Inquire about competition format, dates, and fees.

DEADLINE	COMPETITION
September	**United States Academic Decathlon**—Schools register teams, grades 9-12; state deadlines vary: 6860 Orangethorpe Avenue, Suite A, Buena Park, CA 90620; (714) 522-8723.
October	**Future Problem Solving Program**—Schools register teams, grades 7-12; ask about state affiliates: 318 W. Ann Street, Ann Arbor, MI 48104-1337; (313) 998-7377.
October 15	**Mandelbrot Competition**—Schools register, grades 9-12; request invitation letter by September 15: Sandor Lehoczky, Greater Testing Concepts, P.O. Box 5014, New York, NY 10185-5014; (708) 795-7865; sandor@interaccess.com
October 15	**National Geography Bee**—Principals register schools, grades 4-8: National Geographic Society, 1145 17th Street, NW, Washington, DC 20036; (202) 828-6659.
October 15 or November 1	**American Junior High School Mathematics Exam (AJHSME)**—Schools register, up to grade 8; lower fee for earlier date: Dr. Walter E. Mientka, American Mathematics Competitions, Department of Mathematics and Statistics, University of Nebraska, 1740 Vine Street, Lincoln, NE 68588-0658; (402) 472-2257, fax (402) 472-6087; http://www.unl.edu/amc/
November 15	**MATHCOUNTS**—Schools register teams, grades 7 & 8: MATHCOUNTS Registration, P.O. Box 441, Annapolis Junction, MD 20701; (301) 498-6141. All other questions: MATHCOUNTS Foundation, National Society of Professional Engineers, 1420 King Street, Alexandria, VA 22314-2794; (703) 684-2828.
November 15	**U.S. Senate Youth Program**—Each state nominates two delegates and alternates in grades 11-12 who are elected student leaders: Ask your high school principal, chief state school officer, or office of DoD Dependents Schools.
mid-November	**National German Test**—German teachers register, German II-IV: American Association of Teachers of German, 112 Haddontowne Ct. #104, Cherry Hill, NJ 08034; (609) 795-5553, fax (609) 795-9398.
November 22	**Knowledge Master Open**—Schools enter one team per division (middle, junior high, high school): Academic Hallmarks, Box 998, Durango, CO 81302; (800) 321-9218.
November 29	**Westinghouse Science Talent Search**—Students enter individual original projects, grade 12 only: Science Service, Inc., 1719 N Street, NW, Washington, DC 20036; (202) 785-2255.
December 1	**ACSL Computer Science Contest**—Schools register teams: junior, intermediate, senior divisions: American Computer Science League, P.O. Box 40118, Providence, RI 02940; (401) 822-4312; info@acsl.org
Other:	**National Spelling Bee**—Scripps Howard, Inc.: Students enter only through a sponsoring newspaper: ask your local press if they participate.

Interested in subscribing to Imagine? Call the JHU Press at (410) 516-6989 or toll-free (800) 548-1784 and ask about our introductory price.

Imagine...
*Opportunities and Resources for Academically Talented Youth**

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The College Selection Process:

YOU CAN TAKE CHARGE!

by Marilyn Colson

Academically and socially, Justin's senior year seemed successful: he was earning good grades, had enjoyed the Harvest Ball, starred on the soccer field. But now in mid-December with college deadlines fast approaching, tension threatened to spoil the holidays. Usually talkative and spirited, Justin had become secretive and super-sensitive of late. Catalogues and viewbooks littered his bedroom floor, and incomplete applications covered his desk. As the intensity of family arguments increased, so did his apparent paralysis. The whole process of applying to college seemed overwhelming....

Negotiating the college admission process need not be a hassle. With guidance, planning, and organization, choosing a college can be a positive experience. Except for the fat or thin envelopes that will appear in your mailbox in the spring of your senior year, you can be in charge of every aspect of applying to and selecting a college.

If you aspire to attend a highly selective college or university, you can choose to take the most challenging courses in secondary school and work hard to do well in those courses. You can become involved in extracurricular activities that genuinely interest you. And you can tackle the college admission process seriously, researching the characteristics of particular colleges, working hard on writing good essays, and getting the completed applications in on time.

Assess Your Needs

Although the possibilities for your college choice seem endless, a starting point does exist. Don't ask first, "What are the colleges like?" Ask instead, "What am I like? What do I require?" Who you *are*—not who others think you should be—is crucial to your college choice, for you will be happiest in an environment that best suits your personal needs. First and foremost, you'll be looking for academic challenge and intellectual stimulation. But you'll also want to find a place where your evolving social self will be comfortable.

What type of environment will best fit your personality? If you are shy or want personalized guidance as you make academic choices, a small and nurturing campus community may serve you well. If you are extroverted, have assumed leadership roles, and can fend for yourself without a lot of guidance, a large university may suit you better.

What type of student population fits best with your interests? Do you want a politically active campus? Are your goals most compatible with those of preprofessional students? Or do you prefer an environment that focuses on athletics as well as academics?

What about geographic considerations? Would you prefer to stay near home or to experience living in another part of the country? Are you energized by urban life, or are you most fulfilled by a quieter rural environment?

Investigate Colleges

After considering the questions that will help you define what you're like and what you want, you can begin to identify the colleges that suit your needs. Narrowing the options may seem a daunting prospect, but it will soon become clear that not all colleges meet your requirements.

Begin collecting college catalogues and viewbooks. *Read* them. Seek the advice of your parents, school guidance counselor, and favorite teachers. Give some thought to the academic areas that most interest you, and compare the strength of those departments on different campuses.

The best way to discover which kind of campus will feel like home is to try some out. Begin by visiting colleges near your hometown, even if you know you will want to enroll farther away. Whenever you have the opportunity to travel, check out colleges along the way. Attend campus open houses; take the guided tours. Keep a journal about your visits, noting your likes and dislikes for future reference.

Each campus has its unique personality, and the more you experience the feel of different environments, the clearer your preferences will become. Consider Bowdoin College, for example. Located only a few minutes from the picturesque Maine coast, Bowdoin enjoys an impeccable academic reputation. It's glorious in the fall, and ice hockey enthusiasts love the winter. But if you hate cold weather or love the city, is Bowdoin where you want to be? If you prefer a city with a warmer climate, Emory University in Atlanta may be a better choice.

To find out what life is *really* like at a specific college or university, ask the experts: the students themselves. Question your campus guides and others you meet while touring. Talk with graduates of your high school and other older friends who are now in college.

Into the Home Stretch

When it's time to fill out applications, you'll need to call upon (or quickly develop) solid organizational skills. Start a calendar devoted to the admission process; note the various deadlines for applications. Set aside plenty of time to fill out forms, write compelling essays, and get the appropriate recommendations.

The key to making a decision you won't regret is to give the college selection process the careful consideration it deserves. If you've taken charge and planned ahead adequately, mid-December of your senior year should find you and your family enjoying the holiday season, instead of battling over deadlines and missed opportunities.

Then all you have to do is wait for spring...

Marilyn Colson, *M.S., is a Baltimore-based educational consultant who helps students determine their secondary school and college options.*

Everything You Ever Wanted to Know…

INTERVIEW WITH A COLLEGE ADMISSIONS DIRECTOR

by Susan Hellerman

Paul White is Director of Undergraduate Admissions for both the Kreiger School of Arts and Sciences and the Whiting School of Engineering at The Johns Hopkins University. He previously worked in admissions at Yale and Colgate Universities and at Hamilton College.

We encourage our readers to begin planning ahead for college from the time they're in middle school. Would you agree with this advice?

Absolutely. You can't afford to wait until your third year of secondary school to get serious about college. Admissions officers look at your transcripts from the ninth and tenth grades, too. And not just at your grades, but at the courses you've chosen to take. So you need to chooose your curriculum carefully. Middle school is not too early to begin.

Let's leap ahead. Suppose I'm applying to Hopkins. What would you like to see in my high school transcript?

First and foremost, we need to know that you can handle the academic challenge here—and not just do the work, but flourish intellectually on this campus. So, at the most basic level, I'm going to look at your academic preparation.

We recommend that your high school curriculum include four years of English, four years of mathematics, three or four years of a foreign language or two years for engineering majors, two years of science with lab, and two or three years of history and social sciences. However, for you to be competitive in our admissions process, these basics should be demanding courses. If, for example, you're taking only trig or precalculus as a senior, you'll be at least two math courses behind most Hopkins applicants.

Therefore, I'm going to look beyond your GPA to question the *level* of the courses you've taken: have you chosen the most academically challenging courses available in your school?

How would you know the answer to that question?

With every application, we ask for a school profile that details academic courses available to the student and may include information about median SAT scores. Also, our admissions counselors have regional assignments. They get to know the schools—and ideally, the school counselors—in their areas. Then, when we're reviewing applications, the regional counselor can draw upon that knowledge to say, "Yes, this student has all *A*s, but the course load isn't that strong; I know the school has more advanced course work available." Or, "I see a couple *B*s, but they were earned in the most rigorous courses the school offers."

You're not necessarily looking for a perfect GPA?

Again, we're looking for students who can handle the academic challenge here. If your transcript shows that you've played it safe, going for the *A*s rather than the intellectual challenge, that's a red flag.

I like students who are willing to take academic risks. Suppose, for example, mathematics is your greatest strength, but because literature interests you, you elect to take some literature courses. That's great! You're really showing us that you're willing to stretch yourself, to try something different, even at the risk of getting *B*s instead of *A*s. If your record shows that you sought out challenges in secondary school, then I believe you can do it here, too.

What if I'm attending a small high school with limited resources?

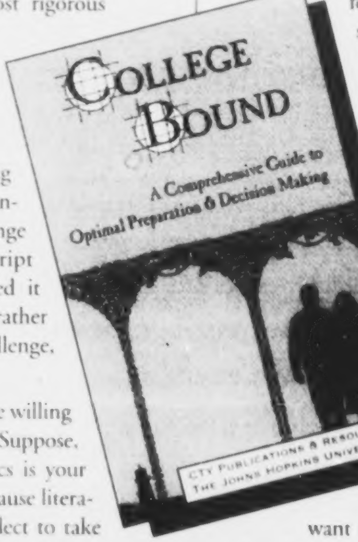
If you haven't had extensive opportunities, but have taken the most demanding courses available in your school, you won't be penalized during the initial process. But sometimes when we are making final decisions, we have to cut and may decide that your record isn't as competitive as others'.

If your school has limited resources, I'd recommend that you supplement them with summer study or other academic options.

If I'm homeschooled or younger than the average applicant, how will these factors affect my application?

Applying as a homeschooler today isn't as difficult as it was 15 or 20 years ago when most colleges didn't know what to do with such students. Homeschooled students go through the same process as everyone else, being considered on a case-by-case basis. Obviously there are some differences—you can't give us a school profile, for example. But we need to know how well you did relative to students who attend school; you still have to take the standardized exams.

If you are much younger than the typical applicant, I might insist that you come in for an Admissions Office interview, as well as meet with the Dean of Students, so we may judge the level of your emotional maturity. We want to be sure that you'll be able to handle not only the intellectual challenge but also dorm living and other college



COLLEGE BOUND

A Comprehensive Guide to Optimal Preparation & Decision Making

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experiences. It's really for your benefit, to make sure you're ready for us. Hopkins, like any other selective school, is not an easy place even if you're 18.

How much emphasis do you place on SAT scores?

Test scores in and of themselves aren't the most important factor, but they are one of the factors we consider. Significant discrepancies between your SAT scores and your academic record do raise concerns. If you have high scores and low grades, we wonder why: Are you so bored in high school that you haven't performed to the ability indicated by your scores? Or have you achieved those high scores through SAT prep courses and frequent retesting? Generally, if you aren't *performing* well, you haven't proven anything just by *testing* well.

Beyond taking the right courses and getting good grades and SAT scores, what else do I need to do?

The admissions process is intensely competitive today, especially at the more selective colleges and universities. With so many students taking the right courses and getting As, we have to look beyond the objective to the subjective: extracurricular involvement, leadership abilities, thoughts articulated in the essay, level of support expressed in teachers' and counselors' recommendations. We want to see a complete package, someone who goes beyond the basic requirements both in the classroom and out. Even so, there are no guarantees—much depends on the competition in a particular applicant pool.

How do you evaluate extracurricular activities?

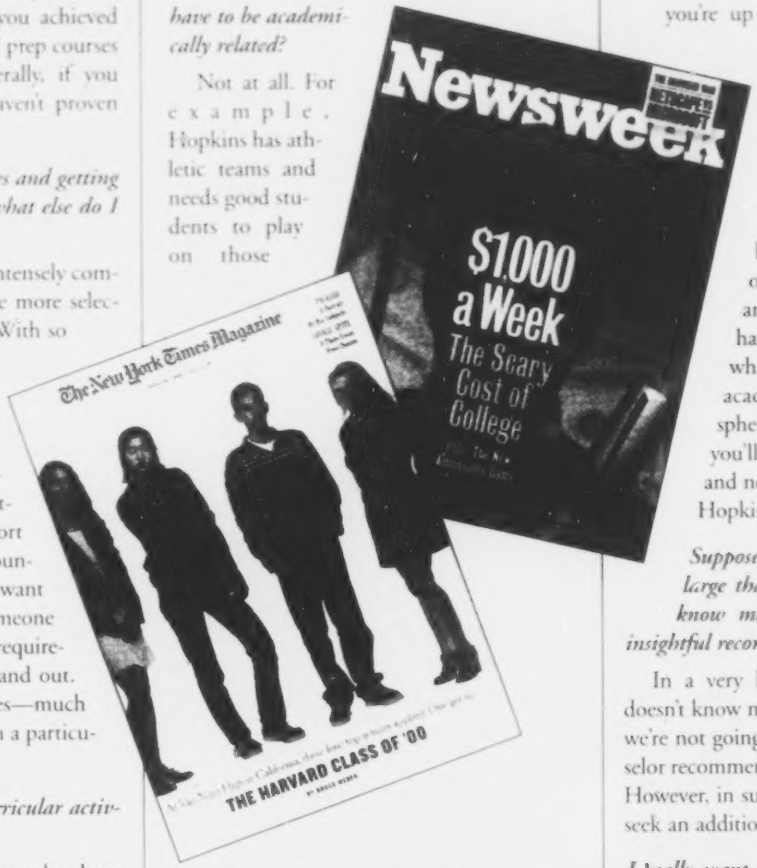
We're looking for students who have shown a sustained commitment to their interests, both academically and extracurricularly. The activities you choose outside the classroom provide information about you as an individual, tell us whether you're likely to fit into the Hopkins community.

So don't show me a laundry list of activities where you've hopped around so much I can't really get a sense of who you are. And don't give me one that suddenly expands when you're in twelfth grade, because I'll know you're only doing those things because you feel you have to.

Instead, show me how you've expressed your creative nature outside the classroom over the past four years. If you're interested in journalism, show me that you've been involved in school publications—and not just involved, but thinking up different ways of presenting issues. Or show me that your interest in poetry led you to help create a poetry journal because your school didn't have one.

Do all my extracurricular activities have to be academically related?

Not at all. For example, Hopkins has athletic teams and needs good students to play on those teams. If you're interested in athletics, tell me what you've learned through that experience.



Or tell me about your volunteer work. We're building a community here. We need people who—besides being scholars—will look beyond themselves, will get involved and add something to the life of this place. If you've demonstrated a sustained interest in service to others, I can be assured that won't cease when you get here. Even if your goal is graduate school, you're still going to be concerned about contributing to the Hopkins community during your undergraduate years.

How important are recommendations?

Since almost all our applicants are exceptional, we rely on the recommendations of teachers and counselors who know you well to help us sort out the best of the best. Have you demonstrated true intellectual curiosity? Or have you just worked hard to get good grades? You may have succeeded in secondary school doing your work by rote; however, the challenge in college will be much greater. We need to know whether you're up to that challenge, whether your recommenders have seen any glimpses of your ability to do the level of work we want you to do at Hopkins.

We hope that the school counselor will tell us if you have made good use of the opportunities at your school and in your community. If you haven't taken full advantage of what has been available in both academic and non-academic spheres, then I question whether you'll make good use of academic and non-academic opportunities at Hopkins.

Suppose my graduating class is so large that my school counselors don't know me well enough to write an insightful recommendation?

In a very large school, "my counselor doesn't know me" is certainly a valid excuse; we're not going to penalize you if the counselor recommendation isn't very informative. However, in such a case, it behooves you to seek an additional teacher recommendation.

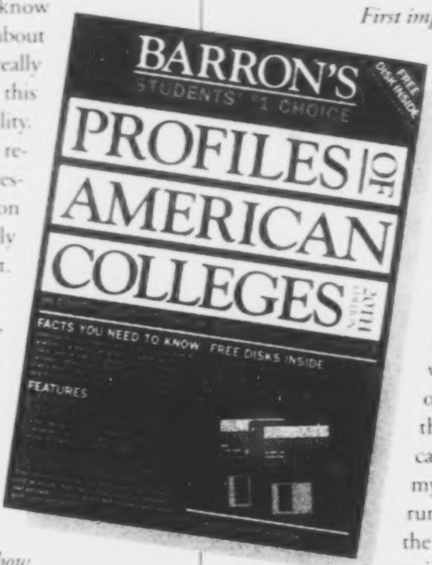
I really want my application to stand out. Should I package it creatively, send you a video, write a quirky essay?

Over the years, I have seen a lot of gimmicks. I remember one person who sent in a shoe, another application that arrived on a four-foot-high piece of cardboard—which made no sense. In the '80s, we had shelves of videos; eventually we just stopped viewing them. This year we received 8,500 applications—a record number; time is a factor here.

continued on next page

Be straightforward. It's hard to come up with something truly creative, so if creativity is not part of your character, it'll fall flat. We won't deduct points, but you certainly won't win any points with gimmicks. And we've all read *Essays That Worked.*

I'd much rather see a carefully thought out, well written essay and learn who you are by what interests you, what you value. I know everyone talks glibly about values today, but we really want to know about this aspect of your personality. In fact, last year we redesigned our essay questions to elicit information about what is truly important to the student. Two examples: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FEATURES

"The house of the soul," "a musical instrument," and "machine" are three examples of the many metaphors that are often employed to describe the human body. Write an essay in which you examine how the use of metaphors affects the ways in which we study human life, see our bodies, take care of ourselves and others, or define health. Be sure to include and explain your own metaphor for the human body.

At Hopkins, a political science professor uses contemporary fiction by African authors to teach about the politics of southern Africa. If you were to design a course around the music, art, film, or literature that you like, what would that course be about? What would you hope to teach your students? Please include a listening/viewing/reading list with your essay.

Can I prepare myself for the personal interview? What do you look for?

We look for interest in Johns Hopkins. So, yes, we expect you to prepare. Do your homework, read the catalogues and other available materials, and be ready to ask specific questions. Come prepared to talk about why Hopkins appeals to you—and to talk about yourself, what interests you, why you've chosen certain studies or activities.

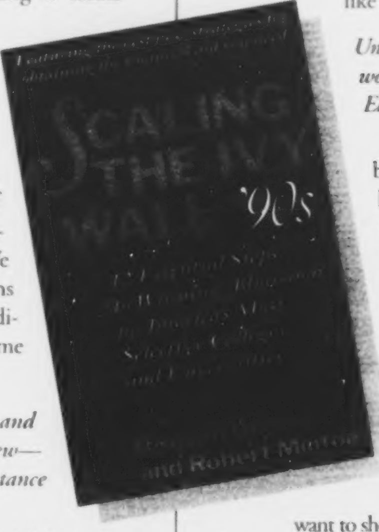
Hopkins does not require a personal interview, so if you request one—whether on campus or with an alum—make it worthwhile. If you're not prepared to ask and answer basic questions, if you haven't done any thinking at all about Hopkins, that tells us a lot. Then we have to wonder why you're having an interview; frankly, it's a waste of your time—and of ours.

First impressions can be important. For example, will you notice how I dress?

We're not overly concerned with your appearance, but how you dress does make a personal statement, which can be positive or negative. You certainly don't have to wear a suit, but everyone can wear something that signals, "I care about how I present myself to others." I have run into students over the years who come into an interview wearing short shorts. All right, you may wear those at home, but you're not at home. You certainly wouldn't dress this way for a job interview.

Body language also makes a statement. I've seen students slouch back in their chairs as though they're just taking a casual approach to the interview; I can interpret that as, "I really don't want to be here."

The main purpose of the interview is to make sure that you leave with a sense of Hopkins, with accurate information about Hopkins. We hope to dispel any myths about the college, and in addition we hope to gain some extra insights about you.



Suppose I'm really nervous and make a mess of the interview—are my chances for acceptance ruined?

The interview isn't so crucial, just one factor among many. If you come with the highest recommendations and have a disappointing interview, it doesn't mean that you won't get in. If it's the only negative, if you have done a good job with your application, written a thoughtful essay, have outstanding references and stellar course work, I would say you just had a bad day and discard it.

Do you recommend applying Early Decision? Will it increase my chances of being accepted?

I would encourage you to apply Early Decision *only if* you have done careful homework before deciding on Hopkins and if you know that you fit our profile. Doing careful homework means that you have visited the campus, stayed overnight in a freshman dorm, looked at other colleges, had your questions answered, and decided Hopkins is the best place for you.

Statistically, the acceptance rate for Early Decision applicants is much higher than for the regular pool: this year Hopkins accepted 60% of those who applied Early Decision—about a quarter of the class—versus 38% from the regular pool.

Applying Early Decision can be an absolute godsend for some students who are competitive but wouldn't be as competitive among the larger numbers in the regular pool. Sometimes a student we denied or waitlisted in the regular pool would have stood a much better chance earlier. I'm speaking specifically about Hopkins, but this is true for many schools like Hopkins.

Under what circumstances would you counsel against Early Decision?

Don't apply early just because you think you have to. If your mind isn't really made up, and you find yourself committed to a particular school prematurely, you're going to be miserable.

Also, if you had some academic problems earlier in secondary school and want to show us a record with consistent improvement, you'd do better to

continued on page 21

GOING PUBLIC

The Powerful Pluses of Undergraduate Education at State Institutions

by Lesley Mackay

Today, few prospective college students can truly say, "Money is no object." With private tuition rising at alarming rates, public colleges and universities look more and more attractive. The best news is that state institutions can also provide a high quality, even first class, education.

Many students who excel in school look forward fervently to their college years. No matter how interesting and enjoyable high school life can be, college seems to promise so much more. For motivated, talented students, the college years provide unparalleled opportunities for discovery, challenge, growth, and friendship.

Of course, the exhilarating prospect of college rests partly on an important question: where? When it's time for you to narrow the field, which colleges and universities will make it onto your short list? Your top choices will reflect your aspirations ("I aim to master the Romance languages and play in a top-notch orchestra"), your preferences ("I want to attend a small liberal arts college"), and your needs ("I have to keep my tuition costs down").

For a variety of reasons—cost prominent among them—many highly able students will want to look hard at their own and other states' public institutions.

A RANGE OF PUBLIC OPTIONS

State institutions offer a multitude of options varying in size, in selectivity of admissions, in diversity of opportunity, and in the quality of undergraduate instruction. Even tuition and availability of scholarships differ from one campus to another. You can find almost any kind of educational environment within the spectrum of public colleges and universities.

In *The Public Ivys*, author Richard Moll calls attention to the fact that public colleges and universities can offer the academic excellence and range of opportunities associated with the most prestigious private schools. Moll spotlights the following institutions as prototypes of some of the best in the public sector: (1) the multi-campus University of California, featuring Berkeley; (2) Miami University of Ohio, in Oxford; (3) the University of Michigan at Ann Arbor; (4) the University of North Carolina at Chapel Hill; (5) the University of Texas at Austin; (6) the University of Vermont at Burlington; (7) the University of Virginia at Charlottesville; and (8) the College of William and Mary, in Williamsburg, Virginia.

Photo by Larry Murphy

Viewing the West Mall from Guadalupe, at the University of Texas at Austin

Money magazine and *U.S. News and World Report* have also spotlighted high quality public institutions as "best buys" or "best values" in college choice.

Even public institutions without overall top billing can have a lot to offer. Less selective, less prestigious public institutions may maintain challenging honors programs and strong individual departments, as well as open climates that allow talented undergraduates to take graduate courses and engage in research opportunities.

You have to get to know the different dimensions of a school before you can accurately judge what it has to offer you. Let's look at some of these up close.

SELECTIVITY OF ADMISSIONS

Public schools of higher education are committed to helping meet the educational needs of their own state residents. As a result, most seats in each incoming freshman class at state universities are reserved for in-state candidates. For example, in 1993-1994, 93% of the undergraduates at the University of Illinois at Urbana-Champaign were Illinois residents, and 90% of the undergraduates at the University of California at Santa Cruz hailed from California.

But only 65% of the undergraduates at the University of Virginia at Charlottesville and at the College of William and Mary were Virginia residents. This lower proportion makes admission to these colleges more competitive and selective and forces less qualified in-state students to consider other campuses. Highly competitive admissions and the greater diversity resulting from more out-of-state students contribute to the atmosphere that one associates with selective private institutions, thus maintaining the "Public Ivy" image enjoyed by these two institutions.

In general, the competitiveness of the admissions process depends on the number of highly promising applicants among out-of-state and particularly in-state candidates for the number of available spaces. Public institutions can be very selective, with more rigorous admissions standards than those that prevail at many private schools.

Barron's Profiles of American Colleges lists the College of William and Mary, New College of the University of South Florida, and the University of Virginia as among the "most competitive" when compared with other schools. And several larger state universities fall into *Barron's* next most competitive category, including the University of California at Berkeley and at Los Angeles, the University of Florida, and the University of Michigan at Ann Arbor, to name just four.

LARGE OR SMALL: PUBLIC INSTITUTIONS COME IN ALL SIZES

New College of the University of South Florida has only about 500 students. The University of Maryland's St. Mary's College has about 1,300 students. The College of William and Mary enrolls about 5,000 undergraduates, Georgia Institute of Technology about 8,500. And Ohio State University in Columbus and the University of Texas in Austin are among the largest state universities, with about 30,000 undergraduates on each of their campuses.

Size, above all else, dictates the diverse nature of public institutions. Just as with private colleges and universities, size affects selectivity, atmosphere, and educational opportunities and resources.

Small Public Liberal Arts Colleges

Many people think of all state universities as exceptionally large entities. However, a surprisingly large number of small public liberal arts colleges offer an alternative to students attracted to small classes, compact campuses, and individualized attention.

New College of the University of South Florida is an example. Established in 1960, it serves as the honors college of the State University System of Florida. At highly selective New College, academic pursuits require a great deal of student self-direction. In consultation with faculty members, students design and fulfill seven contracts outlining work plans in different areas. In addition, they complete three independent study projects and a senior thesis prior to graduation.

St. Mary's College in Maryland, another public honors college, features a more traditional academic credit system. Like New College, it provides a close-knit community and an excellent liberal arts education.

Still another example is the University of Minnesota at Morris, which was featured in *U.S. News and World Report's* 1995 review of colleges. U.M. Morris is one of a dozen colleges that form the Council of Public Liberal Arts Colleges, an organization that aims to promote these smaller institutions as alternatives to both large public universities and expensive private liberal arts colleges.

Public Universities

Students seeking the greater breadth of resources and opportunities of a university also have numerous options in the public sector. More diverse course offerings and majors, state-of-the-art research, and virtually unlimited extracurricular activities are among the opportunities more prevalent at a university than at a small college, whether public or private.

Suppose a large state university appeals to you because of price or location or availability of resources, but you are concerned about size or academic caliber. Then you should explore the availability of honors programs, the strength of individual departments, and the possibility of advanced opportunities such as research to enhance your experience as an undergraduate.

At University of Southern Florida in Sarasota, a New College student reads in the shade by College Hall.

Honors Programs

Of all the features of a large public university, honors programming may be the most significant for well prepared, ambitious students. University honors divisions enable undergraduates to enjoy the best of both worlds: the breadth of resources and opportunities of a large university *and* the intimacy and greater rigor of the smaller program.

If your home state university has a well developed honors program, learn as much about it as you can. You may find opportunities that stack up well against those available at even the best private schools—not to mention the additional options and resources provided by the university as a whole.

One student, a junior at Arizona State University, told us, "The University Honors College made all the difference for me. Its faculty and administrators give their students the kind of guidance and personal attention you look for in a small school—yet all of this is available along with the resources of a large university." She added, "My honors courses have enabled me to make valuable professional connections and get to know my professors. This has brought me teaching and research opportunities—as an undergraduate."

Excellent Individual Departments

If you have a well-defined sense of academic direction, you may want to consider an essential strength of many public and private universities: excellent individual departments. A large state university, even one that is not nationally prestigious, may nevertheless possess one of the strongest departments in the country in the area that interests you.

Examples of departmental excellence abound, as noted in *The Gourman Report.* Driven to journalism? Check out the top-ranked program at the University of Missouri, as well as others at the Universities of Minnesota, Illinois, North Carolina, Wisconsin, and Ohio State University. Mad about geography? The number one U.S. program is at the University of Minnesota. How about math? Berkeley, Wisconsin at Madison, Michigan at Ann Arbor, UCLA, and Illinois at Urbana-Champaign rank in the nation's top fifteen. Indiana University and the University of Virginia top the list for religious studies. Botany may be best at the University of California at Davis.

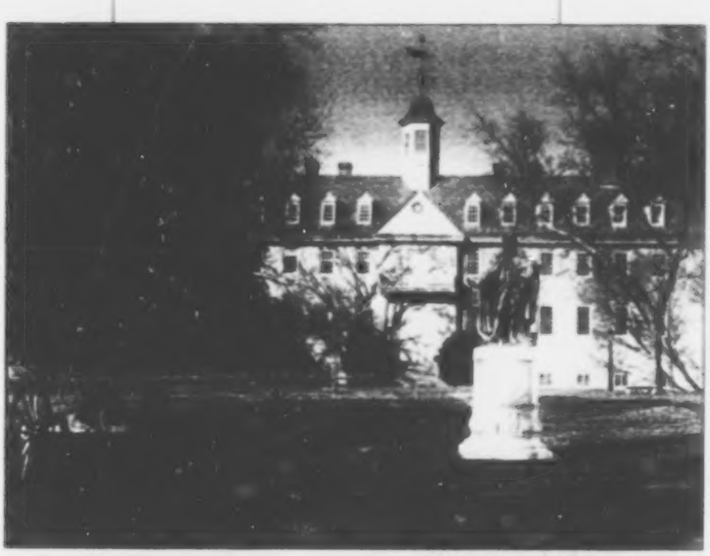
One caveat: Students should not enter college planning to camp out in one department. A broad-based liberal arts education is a time-honored, important ideal. And the realization of this ideal does depend, in part, on the quality of an institution as a whole. However, selecting a university that is excellent in your primary area of interest as well as quite strong on the whole may be an optimal balance for some prospective freshmen.

If a particular department interests you, be sure to ask questions about its orientation and focus. These can differ in many fields, even in strong departments. For example, some psychology departments emphasize cognitive approaches, others counseling and educational applications. Be sure the institution you choose to attend will allow you to study in a way that will stimulate and continue to engage you.

Faculty and Research

Essential to departmental excellence are, of course, outstanding professors. Public universities continue to attract topnotch faculty—with good reason. The research environment at many public universities is often strong in particular areas. In fact, state funding combined with access to private sponsorship can provide public institutions with more ambitious research programs than those available at many of their private counterparts. The University of California at Berkeley and the University of Michigan at Ann Arbor are examples of our nation's greatest research universities.

Ambitious and well-prepared undergraduates may be able to obtain opportunities for advanced work that usually fall to graduate students. On the negative side, undergraduates in departments with a dominant research focus may find class sizes large and professors relatively inaccessible. However, this may cease to be true after freshman year, when classes thin out and students begin to enjoy expanding opportunities to establish themselves. Academically talented students can avoid some of these large classes by entering with Advanced Placement credits from high school so they can take classes with upperclassmen from the time they arrive.



©Gleason/VISCOM Williamsburg, VA

The College of William and Mary in Williamsburg, Virginia.

AND THEN THERE'S THE COST...

Above all else, what distinguishes a public institution of higher education from a private one is, of course, the cost. Not only is the price tag lower, but academically talented students often find themselves being wooed by their state university with merit-based scholarship offers. This can be appealing to students who don't qualify for need-based aid, as well as to those anticipating the later costs of graduate school. Even out-of-state students, whose tuition is higher than that of in-state residents, find public education a bargain.

A relatively new, but expanding, phenomenon in higher education is that of prepaid tuition programs offered by some states. With these programs, a student whose parents pay in advance into the system is guaranteed a fully paid education at a state institution, provided the student is accepted. This offer is good irrespective of tuition increases. These popular programs are contributing to increased interest in public colleges and universities.

But public education was popular before such tuition payment programs were available. A 1990 graduate of SUNY-Binghamton in New York gave an emphatic endorsement of his undergraduate education:

> *I am forever grateful for what I received at SUNY. It is a first-class school, and I got an excellent education. Furthermore, my undergraduate expenses were so moderate that afterwards I was able to study again, earning a master's degree in journalism. This is something I would not have been able to do had I overspent on my first four years of higher education.*

CONCLUSION

Like private colleges, public ones come in all shapes and sizes, offering myriad options. You will want to consider all alternatives—public and private—as you seek the college or university that best meets your own needs. ■

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In Retrospect: How We Got the Most Out of Campus Visits

This father and daughter share some of the lessons they learned from an extensive college hunt. Even if you don't choose to be quite so thorough in your own search, the insights offered here can help you tailor campus visits that will yield the information you most want and need.

by Robert Suderman and Tamara Suderman

Robert: Our family has been through two college search cycles, first with our older daughter, Dara, and then with Tamara. After some initial trips that weren't as helpful, we learned to structure campus visits so that they became an invaluable part—in fact, the keystone—of our college search process.

Tamara: Having watched my sister go through the process, when it was my turn, I was concerned about finding a good subjective fit, rather than simply choosing a school for its reputation. Schools that look very similar in *XYZ's College Guide* can be quite different in person. By confirming (or refuting) impressions I'd already gained and by generating new information, campus visits really helped me clarify my choice.

Robert: Actually, the campus visits were not the *first* step in the process, but one of the last. The homework we did before we hit the road helped us focus our efforts.

We began by reading Thomas Sowell's marvelous book, *Choosing a College*, which we found to be the most concise, straightforward, and clear-headed overview of the search process. It's out of print, but copies can often be obtained from used book stores or libraries.

We also read college guide descriptions of the local state university and a nearby college, among others, to assess how accurately various guides treated schools about which we already had some knowledge.

Tamara: The initial winnowing process may have been easier for me than for some people. I was fairly sure I wanted to attend a small- or medium-sized, academically excellent school in the South, Midwest or Northeast—although I do tend to prefer a warmer, milder climate (both atmospheric and social). I knew I wanted to major in biology, so that also helped narrow the field.

We collected hard facts from college catalogues and guidebooks: SAT score ranges, academic-year calendar, size of student body, preprofessional/research orientation, urban/rural setting. We also wanted more impressionistic data best gathered on site: campus security, character of the student body and campus social life, academic intensity, and faculty. So a visit was crucial.

Scheduling Visits

Robert: Scheduling a visit to a single school is relatively simple; trying to visit four or five campuses on a single trip takes a great deal of planning for appointments, reservations, and so on. Several months before a planned visit, we requested information about research interests of faculty members in biology. Once we had this information, we were ready to call the colleges.

Tamara: I usually tried to schedule an overnight stay in a dorm along with an entire day on campus. Since overnight slots are often limited, our first call was to arrange this with the Admissions Office. We learned the times of campus tours and information sessions, then called the professors whose academic interests were similar to mine and asked to meet with them. Whenever possible, these appointments were scheduled for afternoons so I had mornings free to sit in on classes. Finally, my father arranged to see a Financial Aid officer while I was in class.

Evaluating Campus Security

Tamara: We quickly learned that if you ask a vague question—"How safe is the campus?" —you'll get a vague and not very helpful answer. Instead, we asked specific, personalized questions: "At 2:00 a.m., are there any areas on campus where you wouldn't walk alone? Would you be comfortable and safe walking alone for four blocks in any direction away from campus? During daylight hours? After dark? Is theft from dorm rooms a problem? Do most students lock their doors? If you left a bookbag in the library for an hour, would it be there when you returned?"

Experiencing the Social Atmosphere

Robert: Campus social atmosphere is another important aspect best learned about on a visit. Do you feel comfortable with the social composition of the student body? Does the value system of one group dominate the school? What are the primary non-academic activities on campus?

One way to get a sense of such matters is to read several weeks' worth of the school newspaper. You can gain a good idea of "what's hot and what's not" on campus. At one campus, for example, we found out about several recent racial incidents by reading back issues.

Tamara: The overnight stay also provided a great opportunity to do some amateur sleuthing, observing clothing styles, haircuts, and other visible personal statements. For me, one telling measure was the Mascara Index: what percentage of the female students wore makeup? This varied enormously, from schools where girls would not leave their rooms without it, to those where girls never wore makeup.

Overnights also gave me a chance to talk with students in a much more informal setting than the campus tour and to experience social life on a weeknight. Were the dorms quiet or filled with music and talking people? What about drug and alcohol use? Firsthand impressions were worth a thousand words.

Robert: While Tamara was staying with students or going to classes, I often went off to observe and talk to students. I sometimes took work with me to the library, where I found that students sitting alone at the tables or in the periodical reading areas were often willing to chat briefly with someone else who was working.

Robert Suderman with Tamara, a freshman at Rice University in Texas, and Dara, now a junior at Davidson College in North Carolina.

We tried to eat two or three meals on campus so we could sample the food and see who ate with or away from whom. We invariably found students and faculty cordial and willing to talk to us.

Tamara: When asking about the influence on campus life of the prevailing social/cultural group, we tried to get opinions from both someone in the group and someone outside it. For example, if fraternities and sororities were prominent, we asked both a Greek and an independent. Their assessments of how much one group dominated campus life often differed considerably.

Most of these aspects can only be evaluated during the academic year. While summer visits are more convenient and can be helpful in narrowing your list, I *strongly* recommend academic-year visits to your final, top-choice colleges.

Assessing the Academic Environment

Robert: A school's academic environment is the result of a complex combination of factors—academic rigor, student attitudes, faculty supportiveness, grading policies. We wanted to find a school that offered both academic excellence and a supportive learning environment. College guidebooks were helpful in portraying a school's overall academic character, but we also wanted more information about the departments in which Tamara would take most of her classes.

Tamara: We always asked several students about the school's relative strengths and weaknesses. Usually juniors and seniors, no matter what their major, knew the top departments by reputation. What made those departments so good: particular teachers, courses, facilities, programs, research opportunities? If biology was not one of the departments mentioned as top, we explicitly asked about how it compared with other departments.

Robert: As a parent, I was concerned not only with academic excellence but also with the academic stress Tamara might experience. As a biology major, she will take all the premed courses—ones that, at some schools, serve a weeding-out function. At one top liberal arts college, for example, the Organic Chemistry course has a median grade of C+ (not the typical median grade for courses at that school). I always asked which majors or courses, if any, had reputations as being unusually difficult compared with the rest of the curriculum.

Tamara: The school I decided to attend identifies its most difficult and time-consuming undergraduate science courses, describing the demands they make on students and recommending careful consideration before taking them at once. I appreciate the fact that Rice makes the effort to help students devise manageable schedules.

Robert: Another kind of stress students at many campuses face concerns class close-outs: courses that are perennially overbooked and must exclude some of the students who sign up for them. We always asked students, "How many classes have you or your roommate been closed out of in your years here? In which departments and classes are close-outs a problem?" We didn't want this sort of problem to come as a surprise.

Meeting Professors

Tamara: Talking with individual professors was very useful, as we gathered detailed information about programs, research opportunities, and facilities and equipment. I also got firsthand impressions of the accessibility and personality of professors with whom I might work. If I didn't sense a match, I would certainly rather know before making my decision to attend that school. (The fact that, at one school, I couldn't even *talk* to a faculty member—undergraduates dealt only with a secretary—spoke volumes about faculty accessibility there.)

Robert: As an added benefit, professors who were especially interested in Tamara as a prospective student sometimes served as advocates for her in the admissions and scholarship process.

Scouting for Financial Aid

Robert: That brings up a final point: financial aid and merit awards. These varied *significantly*, even among comparable schools. One school had to be eliminated from final consideration because its financial offer was so much lower than others'. If aid will be a major factor in your decision, it's wise to err on the safe side and over-apply.

Coda

Robert: One side benefit of the campus search process was the chance to collaborate with my daughters. I gained new respect for them as we sought information and made decisions jointly. And because we had gone through the process together, I was completely comfortable with the choices they finally made.

Tamara: Although it was sometimes frustrating to put so much time and energy into college selection, I knew I had gathered the information I needed to make an informed decision. I'm convinced I chose the best school for me.

Selected Resources

Let Your Fingers Do the Walking

Thanks to the wonders of modern technology, you can now prepare for a college visit by taking a virtual tour on the World Wide Web. Thousands of colleges and universities maintain home pages--you can call them up specifically (e.g., www.yale.edu) or through a directory such as *Christine DeMello's College and University Home Page:*

www.mit.edu:8001/people/cdemello/univ.html

For additional college-related information:

The College Board Online
www.collegeboard.org

U.S. News & World Report Online College Fair
www.usnews.com/usnews/fair

Yahoo College Entrance Page
www.yahoo.com/education/college_entrance

Or Take the Old-Fashioned Route

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POSTSCRIPT

Reminiscences of a Recent College Graduate

by Amanda Claybaugh

Before I sent off my college applications that December, I took a picture of them all lined up on my kitchen table—I just couldn't believe that they were finally done. Then I began the interminable wait.

My friends and I talked only about our dream schools; my parents asked me only about my safeties. Every day I measured and re-measured my chances, wondering where my GPA would fall in the applicant pool and how many people had listed more activities than I had. Every night I flipped through a college guide with my eyes closed, telling myself that this time the book would fall open to the college I would attend. Months passed.

Finally, in April, the envelopes started arriving, and most of them were heavy, which meant acceptances. After a frantic round of final visits, I decided to go to Yale. As I checked the box on the postcard they sent me, I felt that I had just made the first, and most important, decision of my adult life.

Off to college with a small box of books and a huge desire to be educated. I began reading Kant and reconsidering my values—then making friends who forced me to reconsider them once more. I began looking at contemporary art and asking why it was art—then wondering what a critic does, anyway. I began noticing the injustices around me and joining groups to right them—then confronting the limits of political action. By the time I returned home for summer vacation, with cartons and cartons of books, I was on my way to becoming a thinking person. When people asked me how I liked Yale, I said that I loved it. I said that I was getting a great education.

Then my younger sister started applying to college. She bought her own college guides and started calculating her GPA and worrying about her SATs. And I found myself telling her, as she grew increasingly anxious, that it really didn't matter *where* she ended up going to school. Even as I was getting a great education at Yale, I was realizing that I could have gotten an equally good education almost anywhere.

So, as my sister busily weighed the advantages of small schools and large ones, schools in the country and in the city, I was giving her other kinds of advice: "Be sure to visit your professors during their office hours," I told her. "Be sure to do the supplemental reading. Learn your way around the library. Always go to class." When she was accepted by Wellesley, she thought she had assured herself of a good education. But it wasn't until she first stayed after class to follow up on a point her professor had made that I knew her education was guaranteed.

While I may have chosen to go to Yale because of the tremendous resources it offers, every day after that I had to choose to make use of them. I had to make appointments with the brilliant professors, search out the obscure journals, sign up for the many activities. At my graduation, there were students who had spent four years forging connections with their professors, four years reading everything they could find, four years writing symphonies and directing plays and studying languages in their spare time. And there were also students who had hung around and watched TV and spent most of their class time sleeping. We had all gone to Yale, but some of us had gotten good educations, and some of us had gotten bad educations.

The truth is, the student matters more than the school. College students who return their surveys to the staff of *Imagine* echo this idea: After praising Harvard highly, one student wrote, "It's important how you do once you get there, not necessarily where you go." Another student said, "I love Michigan, though sometimes I wonder if I couldn't receive just as fine an education at my own state university." Reflecting on a haphazard admissions process, another reported, "Although I did everything wrong, I lucked into the perfect college for me—or I made it so." All these students suffered through long and harrowing months of applications and essays and recommendations, only to find that acceptance by a top school is a beginning, not an end.

My final advice? Think about what you want in a school, then apply to the ones that offer it. Once you're at college, be sure to visit your professors during their office hours, do the supplemental reading, learn your way around the library, always go to class…

Reprinted from Imagine *Volume 1, Number 2, November/December 1993.*

***Amanda Claybaugh**, Yale '93, graduated magna cum laude with a B.A. in English. She is now engaged in doctoral studies at Harvard.*

EXPLORING CAREER OPTIONS

by Lesley Mackay

Interview with Eric Gordon: Art Conservator

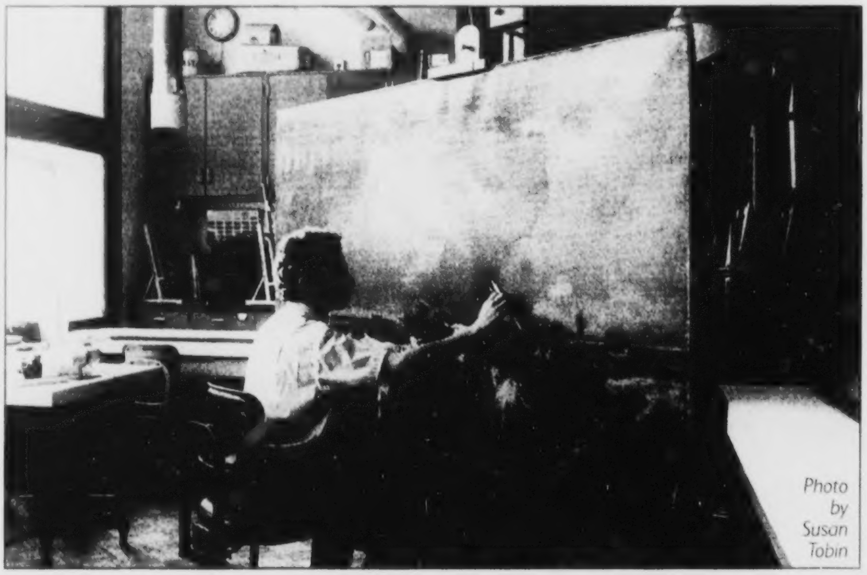


Photo by Susan Tobin

At work in the Walters painting conservation studio, Eric Gordon thins the original discolored varnish on a 19th century painting, The Approach of the Storm *by Emile van Marke. In the background is a 15th century Italian altarpiece by Giovanni di Paolo*

Eric Gordon is the senior conservator of paintings at The Walters Art Gallery in Baltimore, Maryland, where he has worked for eleven years. Gordon has published numerous articles on technical and treatment aspects of art conservation.

What is most satisfying to you about being an art conservator?

One of the major satisfactions is the sense of connection that you can develop with original artists. Whenever you work on a painting, you equip yourself with as much information about the artist and the specific work as possible. Then you begin your actual treatment and discover what makes this painting special. You connect with that private, creative part of the artist in an intimate way. You begin to understand how he or she individually creates.

What does the actual practice of art conservation involve?

Art conservation is made up of the analysis, research, stabilization, cleaning, and restoration of art works. These activities naturally overlap, so conservators tend to get involved in more than one area on each project. However, there are categories of artworks in which conservators specialize. The Walters Division of Conservation has three separate departments: manuscripts and rare books, objects, and paintings.

Stabilization and cleaning are very important. In fact, the primary functions of art conservation are to keep the work from deteriorating and to reveal the existing qualities of the work. We do this, for example, by setting down flaking paint, thinning discolored varnishes, and controlling the environment in which a work is kept.

What about restoration? Do more subjective elements come into play with this activity?

Particular restorations can bear the imprint of the team or individual who did the work. For example, there are schools that believe that all discolored varnish should be removed evenly and down to the paint layer before being replaced with a new, clear coating. Others feel that discolored varnish should be thinned or removed preferentially to compensate for the change that naturally occurs in the aging of the paint layer. In the end, research and analysis guide our process, making it more objective. Information we obtain about the artist's original work determines what is done. We may remove some earlier restorations; we may retouch areas of lost paint. Our goal is always to restore the artist's original design.

Almost everything we do today is reversible. Until about forty years ago, conservators used oils and natural resins that were hard to remove. Then, the advent of synthetic materials, such as those used in dyes and binding agents, made restoration a more reversible activity. Now we are able to make things as easy as possible for those who will care for a work next. We know they may want to change what we have done. This reversibility has contributed to the conservative philosophy of treating art that currently prevails in the field.

The practice of art conservation has gotten more conservative in the last few years?

Oh, without a doubt. I started graduate school in 1976. Then, people were much more into intervening to safeguard art from what might eventually happen to it. So, for instance, in that era, painting conservators would sometimes line paintings with wax and adhere them onto a fabric or solid support to remove warps, stop flaking, and prevent further paint loss. What you have done with these processes is introduce foreign elements into the painting. What we would probably do now is live with present warps or treat them in a less intrusive manner and adjust the painting's environment to prevent future warping. As for flaking, we would simply treat paint locally once flaking became evident.

You mentioned that analysis and research allow conservators to plot the course of a restoration. Is this where science enters into your field?

Research and analysis draw on science, art history, and an understanding of studio art. Scientific techniques help identify many things—for example, the layers of a painting. To treat a work, we must sort out the elements that are part of the original artist's work and the elements that have been added later by others.

Techniques involving x-rays, infrared rays, or cross-section samples can help identify the layers that may exist. We can also approach a painting by looking at the chemical composition of its different colors. Pigment analysis may reveal a shade of blue that came into being after the early Renaissance. If that color is present in a painting held to be from the early Renaissance, the color must be part of a restoration, or the painting may have been misdated in the first place. Knowledge of art history allows you to place scientific information in context. Likewise, knowledge of studio art techniques helps in understanding texture, brushwork, and the use of color.

A conservator's judgment and even intuition are very important, too, especially in the early stages of looking at a work. These personal qualities often guide the process of analysis. That's one reason experience is such an important attribute in this field.

Can you give an example when the importance of experience and judgment was particularly evident?

Our director of conservation was suspicious about a beautiful filigree enamel Chinese wine beaker that had come to our objects division (see photo). The piece was considered to be ancient, an opinion that was confirmed by an expert in ancient bronzes at another museum. But our director then had the piece x-rayed, and the films revealed that the vessel was a fake. In the early 1900s, a forger had welded bits of ancient bronze together with newer pieces. To cover the lines, he had attached bits of corroded metal to its sides. He had also added a thick patina that gave the appearance of corrosion.

What are some of the judgments that conservators typically make about evidence of earlier restoration in the works they treat?

Conservators often decide that earlier restoration must be removed. Removal may be necessary for a variety of reasons. For example, natural products usually do not age as well as synthetic products. An oil-based restoration will age in the first five years and then again over several hundred years, discoloring and darkening. A restorer may perfectly match an original color, but if he or she is using oil-based paint, the restoration will darken. In this case, we would remove discolored retouching and replace it with our own work done with materials that will not alter over time. If there is not a problem with the retouching—if it is not disfiguring—then it is left or perhaps improved.

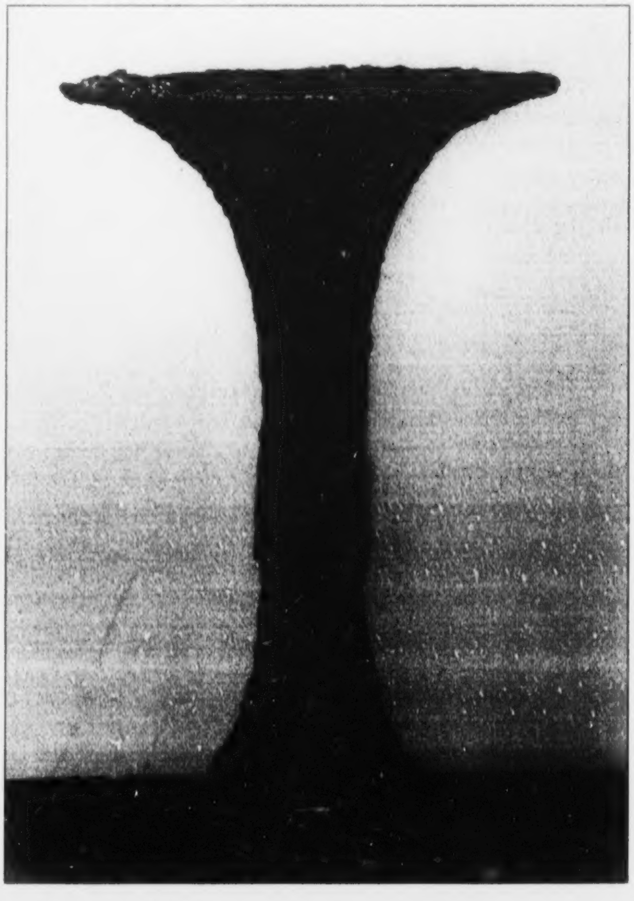
There is another reason retouching may need to be removed: many earlier conservators painted over original paint because it is easier and faster to retouch a painting with broad strokes. On a large masterpiece in our collection by Tiepelo, for example, about 80% of the surface had been covered, even though the many scattered areas of original loss were tiny. It took us almost three years to treat this painting.

While restoration can be overdone, in some cases it can be imperative for the survival of a work. Some paintings will self-destruct because of an original basic flaw, what we refer to as an inherent vice. An example would be Leonardo da Vinci's wall painting, *The Last Supper.* While Leonardo painted this work on a wall, he used the oil techniques characteristic of painting on a panel. The work started disintegrating right away, and restoration began in Leonardo's lifetime.

As your readers may know, a current, ongoing restoration of this particular painting has been quite controversial. The restorer has removed earlier retouching. Some feel that without the work that was added over the years, the painting is more difficult to read. This is because areas of lost paint had been retouched by restorers in the past to imitate what they thought was missing. Without this retouching—with only islands of original paint exposed—the image, I've been told, is less clear.

How did you decide to become an art conservator?

I decided as a result of looking at paintings very much like *The Last Supper.* I attended Brandeis University, where I majored in art history and studio art and also studied languages. I spent my junior year in Italy—one semester in Florence and the other in Rome. In Italy, I saw art up close and personal for the first time. I saw art on walls, in churches, and out in the street. In Italy, you are surrounded by it. It is not a question of attending museums or looking at



Art conservation often involves detective work: x-rays reveal that this allegedly ancient Chinese beaker, clever enough to fool another museum's expert, is instead a masterfully wrought 20th century forgery.

from The Walters Art Gallery, Baltimore slides. The ideal of art fully integrated into the life of a community really moved me.

While I was there, I saw that the way art is treated affects one's ability to see what the artist wanted to express. The distinction between treated and untreated art became very real to me. At the time, I also met up with someone who was studying restoration, and she told me something about the profession. A light bulb went on.

What did you do next?

I came back to the States and, in my senior year of college, made sure that I had fulfilled the entrance requirements for graduate programs in conservation. Because of my double major in art history and studio art, I had most of the prerequisites, but I needed to catch up in chemistry. I also needed to complete one year's internship prior to being accepted for graduate work. I interned at the Isabella Stewart Gardner Museum in Boston, where I worked in paper and object conservation.

That experience was really great, and it provided a lot of firsthand knowledge. The requirement of at least a year's internship prior to graduate work in conservation is a good one and is still in place. It allows people to explore whether they will truly enjoy the work before committing to the field. It allows them to investigate whether they have the personal qualities they will need, such as the patience to enjoy lengthy, time-consuming, detail-oriented projects.

Can you tell us something about graduate work in art conservation and where you decided to study?

Programs exist in Europe, but I decided that I should train in the United States. The European programs tend to be more specialized; you learn about certain kinds of painting techniques in an Italian program for Italian paintings and about Dutch techniques in a Dutch program for Dutch paintings. The programs in the States tend to provide a broader base, although there are programs in England and Canada that are also less specialized.

The three major U.S. programs have slightly different emphases. The University of Delaware's program at Winterthur emphasizes science. The program offered at the State University of New York at Buffalo provides a hands-on, treatment-oriented approach. And New York University's program, which I chose to attend, has an art historical focus; graduates of this program receive an M.A. in Art History as well as a certificate in conservation.

Programs take three or four years, including one or two years of internship. After completing their internships, graduates generally apply for grants or fellowships which can last from one to three years.

Where did you hold your internship at the end of your program?

I had more than one. I studied late nineteenth and twentieth century art at the Hirshhorn Museum in Washington, D.C. And I studied traditional painting conservation at a regional center in Ohio; my focus there was Old Master paintings. Finally, I returned to Italy, where I studied wall paintings.

In part, I diversified so much because at that point in my life I was attracted to traveling; I wanted my profession to take me to different places. But also, I had a strong realistic concern. I felt I needed as broad a base as I could get because of the shrinking job market in art conservation.

Your concerns about funding for art conservation must be even greater today.

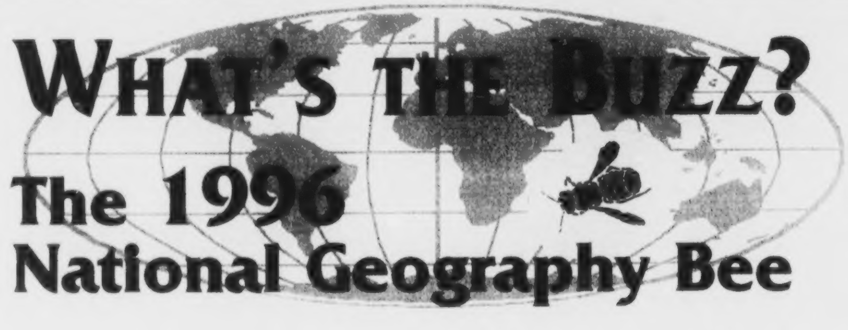
They are. There are fewer positions in museums today than when I first entered the job market. A major factor is the reduction of resources at the National Endowment for the Arts. At this point, the NEA typically funds only one project at every museum; I can remember when we had six or seven NEA-funded projects here at the Walters.

Of course, we try to be resourceful. Conservators can find work in the private sector, and museums can obtain grants from private sources. We were just awarded a grant from a foundation to restore a large fifteenth century altarpiece, a major work of the Italian Giovanni di Paolo. But we do have hidden collections languishing in storage, and I wonder when we will ever get to them.

It is sad that not only arts conservation but also the teaching of art in schools is being drastically cut back. Art can show how marvelous humans are. It can reveal the magical, wondrous nature of our experience. If a society can't preserve what it has of this and make more of it, that's a great loss.

But despite frustrations and sometimes discouraging trends, there are tremendous rewards in the profession. Getting a piece of art back to what an artist originally intended is an incredible process. Working with a piece so that it reveals its creator's innermost thoughts—that's an amazing experience. ■

Detail, base of Chinese beaker (see figure on page 14)



WHAT'S THE BUZZ?

The 1996 National Geography Bee

by Eileen Ptak

After two days of arduous competition, the winner of the 1996 National Geography Bee was determined by one final question: *Name the European co-principality whose heads of state are the president of France and the bishop of Urgel.*

Following Final Round questions, contestants Seyi Fayanju and Ryan Bean faced off for the National Championship Round. Ryan guessed "Monaco," but 12-year-old Seyi correctly answered "Andorra," winning the tournament. Seyi recalled, "I knew it because I read it in an encyclopedia three or four years ago. I just remembered it." For his remarkable powers of recall, Seyi was awarded the Bee's first prize: a $25,000 college scholarship and a Chrysler "Minivan Dream Vacation."

Sponsored jointly by *National Geographic World* and the Chrysler Corporation, the National Geography Bee was designed in response to disconcerting findings from the National Assessment of Educational Progress (NAEP). In 1988, the NAEP administered a test to 3,000 high school seniors to appraise the level of their geographic knowledge. Only 50 percent of the test-takers knew that the Panama Canal reduces sailing time from New York to San Francisco, and only 41 percent recognized the effects of thermonuclear war. A year later, the National Geographic Society launched a massive educational campaign, including the Bee.

Designed for fourth through eighth graders, the Bee begins at the local school level and progresses through various stages of regional competition. Students from all schools that register to participate take oral and written exams; the winner from each school must then qualify to compete at the state level. The National Geographic Society awards the State Bee winners an atlas and geography software.

Seyi Fayanju, this year's champion, used these prizes to help him study for the National Bee, but attributes most of his knowledge to the dedicated atmosphere of learning in his home. An avid reader of maps since age 3, Seyi remembers his first atlas. "My mom bought me the book and from then on, when I was being rambunctious," he said with a laugh, "she would hand me the atlas, like a pacifier. It had a lot of colors, mountains, and places with funny names. I would sit and read the maps and just absorb the information."

Seyi's parents, immigrants from Nigeria, have instilled in him and his siblings a deep love and respect for learning. "My parents are really smart. My mom has an MBA, and my dad is a computer scientist at AT&T." The family's passion for education is evident in Mr. Fayanju's evening conversations with the children. They discuss history and current events and then read more about the countries that come up in their discussions.

If at First You Don't Succeed...

Seyi had participated in the National Geography Bee twice before this year's triumphant win. In 1994, a Gifted & Talented teacher, Mrs. Salge, introduced the Bee into his school. Everyone in grades 4-8 took the exam, and Seyi scored the highest. He then took another test to proceed further in the competition.

About one month later, he received written notification from the National Geographic Society that he had qualified for the State Bee. "I was really excited," he recalled. Seyi placed first in New Jersey and was invited to Washington, D.C., to represent his state in the 1994 National Finals.

"The finals were difficult, and this group was very competitive. I scored 8 out of 9, but three other students scored 9 out of 9, so I was eliminated." Seyi's mother reassured the disappointed 10-year-old and told him to try again next year.

Seyi did try again in 1995, but was knocked out of the competition in the school round by his older brother, Laolu. Seyi laughingly admitted, "I wore a nice sweatshirt and pants because I was pretty confident that I would win." The pivotal question was: *In the Mercator Projection, places at higher latitudes appear more distorted. Which continent is the most greatly distorted by this projection?* Seyi wrote "North America" on his answer card, while his brother Laolu correctly answered "Antarctica." Although this was Laolu's last year to participate, he tried unsuccessfully to forfeit so Seyi could go to the state competition.

...Try, Try Again

This year, after success in his school and state competitions, Seyi became one of 57 students—one from each of the 50 states,

Moderator Alex Trebek congratulates the 1996 Bee winner, Seyi Fayanju, following the Championship Round held at the National Geographic Society in Washington, D.C.

the territories, and the Department of Defense schools—who competed at the national level. Seyi, who lives in Verona, New Jersey, flawlessly answered each question and defeated other top contenders Ryan Bean of Augusta, Maine, and Matthew Conway of El Reno, Oklahoma, who was a '95 finalist. Ryan was awarded a $15,000 college scholarship for his second-place finish, and Matthew won the $10,000 third-prize scholarship.

In addition to Seyi's $25,000 scholarship, Chrysler will lend the Fayanjus a minivan for a ten-day, all-expenses-paid vacation anywhere in the continental U.S. Seyi has chosen New England, where his sister, Lola, wants to attend college. He adds, "I am especially looking forward to Cape Cod and Mystic, Connecticut."

Seyi loves science and is considering medicine as a possible career, but says he will always pursue geography as a hobby. ■

If you are interested in participating in the 1997 National Geography Bee, make sure your school registers by October 15:

National Geographic Society
1145 17th Street, NW
Washington, DC 20036
(202) 828-6659

PUT YOUR GEOGRAPHIC KNOWLEDGE TO THE TEST!

Try these Final Round questions from the 1996 National Geography Bee.

1. The Maya Mountains, which lie south of Belmopan, are primarily in what country?
2. The first time a team from the Soviet Union competed at the Olympics was at the 1952 summer games, which were held in Finland's most populous city. Give the chronological number of the games and the name of the city where these games were held.
3. For centuries, conch-shell trumpets have been used as a call to prayer by Tibetan Buddhist priests known as lamas. The sound from the shell is symbolic of the dharma, or teaching, that leads to enlightenment. Name the city in Tibet that is the traditional center of this religion.
4. The wooden Hahoe mask takes its name from a village in North Kyongsang Provence. This village is on the southern part of a peninsula in what country?
5. Name the largest Greek island in the Mediterranean Sea.
6. Divers can swim with stingrays at Stingray City, a lagoon in a group of British islands northwest of Jamaica. Name this group of islands.
7. Jaguars are among the rain-forest animals that people can see in Manú National Park. This park, which is near the headwaters of the Amazon, is in what country?
8. Kenya's chief port was founded on an island in the Indian Ocean. Name this port city.
9. Name the river that is the principal source of fresh water for the Sea of Galilee.
10. Name the 16th-century Flemish geographer who designed a map projection for use in navigation, and who is credited with producing the first collection of maps called an atlas.

Answers

1. Belize
2. 8, Helsinki
3. Lhasa
4. South Korea
5. Crete
6. Cayman Islands
7. Peru
8. Mombasa
9. Jordan
10. Gerardus Mercator

MATHEMATICAL PROBLEM SOLVING TECHNIQUES

by Alexander Saeed

The Chessboard

You've been hired to oversee the construction of the world's largest chessboard. For several months, you supervise every aspect of its construction, from paying the workers to keeping the chessboard safe from damage.

Unfortunately, several days before the work is to be completed, there's a severe storm warning. Remember the Blizzard of '96? A mere flurry compared with what is predicted for this storm. You quickly decide to cover the board to save it from the inclement weather.

You call up your supply company and ask for immediate delivery of anything that can prevent damage to the board. All they have in stock are the new "Perma-store" boxes. Although these are usually used for storing vast quantities of items (imagine a really, really big garage), they are highly resistant to bad weather and weigh relatively little.

After doing some speedy calculations, you decide these will have to do. The supply man tells you the size of the boxes, and you realize that each box will exactly cover two adjacent squares (two squares sharing a common side). You glance outside and observe that 62 out of the 64 chessboard squares have been constructed already. From where you are standing, the upper left square and the lower right square are still incomplete. You order 31 boxes from the supply company, telling them to rush the job.

You must now devise a way to cover every square on the chessboard, without overlapping any of the Perma-store boxes because of their incredible height. You also cannot allow the boxes to rest on only one square, overlapping the border of the chessboard, because the boxes will not be stable and could be blown over by the raging winds.

Can you draw a diagram outlining a way to cover all the squares, following the restrictions above? Or will the storm destroy the chessboard?

Look for the solution to this problem in the next issue of Imagine.

In May, Alexander Saeed (17) received a B.A. in biology/psychology and an M.A. in psychology from The Johns Hopkins University. Alex is now doing research in molecular biology under Nobel laureate Dr. Hamilton Smith.

FASCINATING CLASSICS

THEIR EYES WERE WATCHING GOD

by Zora Neale Hurston

Review by
Lesley Mackay & Ned Balbo

Ned: Lesley, I really like this book! Zora Neale Hurston's *Their Eyes Were Watching God*, first published in 1937, is a powerful document of the experiences and aspirations of African-American women in the developing South—rural and small-town Florida, to be exact. Hurston weaves elements of comedy and tragedy as well as a deep sense of social history into this book. Her wise and funny narrator unifies the novel with a voice that combines a literary approach with the richness of the spoken word.

Lesley: I also like this novel very much. For me, Hurston's poetic style, the provocative voice of her narrator, and her tale of facing and overcoming adversity combine to give the whole book a spiritual power. Most of all, I like Hurston's heroine, Janie Crawford. *Their Eyes Were Watching God*, follows the vibrant Janie from her teenage years to her early forties.

Janie's early life is shaped by suffering—not her own so much as that of her mother and her grandmother, who suffered greatly due to racial injustice, cruelty, and oppression. Janie's grandmother was born into slavery; her mother was not. But both women were abused by white men, and both bore children in tremendously adverse circumstances.

Janie's grandmother, in particular, endured so much brutality and hardship that she has little confidence in life or human nature. At the beginning of the novel, when she senses that her own death is approaching, she becomes desperate to see the young Janie secure and protected. The best that a woman can hope for, Janie's grandmother believes, is a predictable life untainted by scandal. And so she convinces Janie to marry a middle-aged man with property, even though Logan Killicks possesses neither charm nor warmth.

Although Janie takes her grandmother's advice when she accepts her first husband, her quest for adventure, growth, and fulfillment has only just begun. Throughout the novel, she strives for real independence, the freedom to live and, most importantly, to love.

Ned: Janie's desires are represented by the image of the pear tree, which embodies the vitality and full sensuality that she seeks. For Janie, life should be joyful and relationships sustaining. Each of her three marriages demonstrates degrees of achieving or falling short of the ideals represented by the pear tree in blossom. Early in the novel, Hurston describes the teenaged Janie:

> *...stretched on her back beneath the pear tree soaking in the alto chant of the visiting bees, the gold of the sun and the panting breath of the breeze when the inaudible voice of it all came to her. She saw a dust-bearing bee sink into the sanctum of a bloom; the thousand sister-calyxes arch to meet the love embrace and the ecstatic shiver of the tree from root to tiniest branch creaming in every blossom and frothing with delight. So this was a marriage!*

Hurston traces Janie's path as she reconciles her desire for an ideal love with the social strictures of her community and with the realities of the larger, deeply imperfect world. Whether it is possible for a woman to love without compromising her independence is perhaps the novel's chief concern.

But Hurston doesn't focus on love alone. The novel raises difficult questions about human life. Can individuals transcend injustice? Can women fully realize themselves? What is the role of God in human life?

Lesley: These questions emerge in many different ways—in dialogue, through the musings of the narrator, through the master plot that traces Janie's life, and through the stories that abound in the novel. Myths, Bible stories, historical anecdotes, allegories, and gossip are basic elements of *Their Eyes Were Watching God*,. Hurston portrays the lives of hardworking, less formally educated people for whom oral narratives are essential. Storytelling binds her characters together and allows them to make more meaning out of their lives. Stories can explain natural phenomena, everyday events, and the mysterious chartings of fate.

Much of this book is set in Eatonsville, a small, developing town made up entirely of African-American residents. Janie moves to Eatonsville with her second husband, Joe Starks, after abandoning Logan Killicks, the man her grandmother urged her to marry. The ambitious and authoritative Joe becomes mayor of Eatonsville,

THE LITERARY REBIRTH OF ZORA NEALE HURSTON

Sometimes, both novels and their authors endure misfortunes and outrages that seem comparable to those that befall their characters. When Zora Neale Hurston's most famous book was published in 1937, it received reviews from male critics ranging from mixed to very negative. Quickly, the work fell into a kind of black hole. It was neither read nor reprinted for the next thirty years. Hurston died in 1960.

The novel resurfaced in the late 1960s, brought back to life first by individual scholars who had discovered it in bookshops and then by word of mouth. In 1971, novelist and critic Alice Walker, who was teaching the novel at Wellesley, learned that Hurston was buried in an unmarked grave in Florida. She went in search of that grave, which she found covered in weeds. Walker then wrote an essay, "Looking for Zora," which was widely read and discussed and which began a new era of scholarly and popular attention to Hurston.

Now, Hurston is considered one of the most important writers in the modern American canon. But according to Harvard-based critic Henry Louis Gates, Jr., it is important not to ignore or sentimentalize her very difficult life. Hurston's life, where storytelling is the chief social activity. The front porch on Joe and Janie's general store serves as a center for exchanging tales.

Ned: Hurston's portrait of the community's storytelling is carefully balanced, expressing both the destructive and the creative sides of human storytelling. From the front porch, one can hear both envious sniping and tales that bring into the open the residents' noble qualities.

One story really stands apart—that of Matt Bonner's mule. This thin, tired animal attracts the attention of the community with its pathetic ill health. At first, people make fun of the creature, but after an outburst of concern from Janie, references to the mule become more compassionate. Eventually, Joe buys the mule to spare him from hard labor, and when the mule dies, it is hauled away with great ceremony.

Lesley: Of course, there's no lack of humor and irony in Hurston's portrayal of the mule's life and death. This episode shows the community's capriciousness: how people can deride and torment one day and honor and sympathize the next. I love Hurston's tongue-in-cheek description of the farewell ceremony for the mule:

> *Out in the swamp they made great ceremony over the mule... [Joe] led off with a great eulogy on our departed citizen, our most distinguished citizen and the grief he left behind him, and the people loved the speech... Sam spoke of the joys of mule-heaven to which the dear brother had departed this valley of sorrow; the mule-angels flying around; the miles of green corn and cool water, a pasture of pure bran with a river of molasses running through it . . .*

Ned: And yet Hurston's approach to the mule is not solely ironic. Exploitation angers her, and the mule provides a humorous yet compelling metaphor for more serious concerns. When Joe pays money to free the mule, Janie compares him with Abraham Lincoln. Elsewhere, Hurston compares the lives of mules and African-Americans. Here, she describes the Eatonsville porch-sitters after a long day's work.

> *These sitters had been tongueless, earless, eyeless conveniences all day long. Mules and other brutes had occupied their skins. But now, the sun and the bossman were gone, so the skins felt powerful and human. They became lords of sounds and lesser things.*

Lesley: Hurston does draw the serious comparison you describe. At the same time, though, she introduces further complications that show how far-reaching the problem of exploitation can be. In the very chapter that features the mule, Hurston draws our attention to Joe's exploitation of Janie. Joe expects Janie to work all day and submit to his overbearing expressions of authority over her. He tries to restrict her social life, too. When the mule dies, Joe refuses to let Janie attend the town ceremony in its honor, even though it was Janie who first spoke up on behalf of the animal. I think that by creating a chain of exploitation, Hurston illustrates that oppression can be perpetuated even by those who have experienced its damaging effects.

continued on next page

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"Zora Looking Impressive" (1938)

Gates writes, reveals "how economic limits determine our choices even more than does violence or love." Hurston spent the last years of her life working as a maid and substitute teacher. Despite having won two Guggenheim Fellowships and having authored four novels, short stories, musicals, two books on folklore, essays, and a prizewinning autobiography, she never attained financial security. She died in a Florida County Welfare Home. The end of her life gave no indication of the esteem in which Hurston and her work would soon be held.

1996-97 series, Literature from Around the World:

- Zora Neale Hurston, ***Their Eyes Were Watching God***
- ☛ Rudyard Kipling, ***Kim***
- Isabel Allende, ***House of the Spirits***
- James Joyce, ***A Portrait of the Artist as a Young Man***
- Alan Paton, ***Cry the Beloved Country***

Ned: Joe Starks eventually ails and dies. His death saddens Janie, but does not undermine her quest for life. Before too long, she meets Tea Cake, a younger man who is much more able to share her exuberant spirit than were her previous husbands. One of the beautiful developments of this book, I think, is that Janie fulfills the dreams of her youth at age forty. Tea Cake helps her to approach and even realize her early conceptions of love.

Lesley: I like the character of Tea Cake very much. But while he does provide Janie with exactly what she wants in a partner and more, he also causes her some pain. Tea Cake can be selfish and self-aggrandizing, like all the men in Hurston's book. But Janie is accustomed to finding trouble mixed with love; she knows how to face the imperfections in her relationship with Tea Cake.

Janie and Tea Cake make a new home away from Eatonsville in the Florida Everglades, or "the muck," as Tea Cake unromantically refers to it. There, they farm and keep house. Their days are made up of outdoor work; their nights are composed of music and talk and the great love they feel for one another. By relocating the newlyweds to a more natural, even primeval, environment, Hurston seems to suggest that the pair had to get away from small town existence in order to experience a love that more closely resembles Janie's ideal.

Ned: Yes, their new location does seem an important part of their new start. Janie is a widow and Tea Cake a single man: they are both free to marry. And yet conventional wisdom holds that Janie should not submit to powerful feelings for a younger man. In the Everglades, Janie finds freedom from much that has held her back: the harshness she sometimes witnessed in her grandmother, the selfishness and mean-spiritedness sometimes evident in her first two husbands, and gossip and envy among her friends.

Lesley: Although Janie does move into a more congenial social environment, Hurston continues to cast a sometimes dispassionate, even journalistic, eye on her characters and their lives. And yet she also sometimes dives into fantastic imagery and the epic language of myth. I found her description of the hurricane that devastates central Florida to have a mythical quality, as if she were allowing one of her character's amazing tales to shape that part of the narrative.

Ned: Lesley, you're from Florida! Haven't you ever experienced a hurricane?

Lesley: I've only ever been at the edges of one. But despite my lack of relevant experience, I still find Hurston's powerful description to be exaggerated—deliberately so, I am sure:

> *The monstropolous beast had left his bed. The two hundred miles an hour wind had loosed his chains. He seized hold of his dikes and ran forward until he met the quarters; uprooted them like grass and rushed on after his supposed-to-be conquerors, rolling the dikes, rolling the houses, rolling the people in the houses along with other timbers. The sea was walking the earth with a heavy heel.*

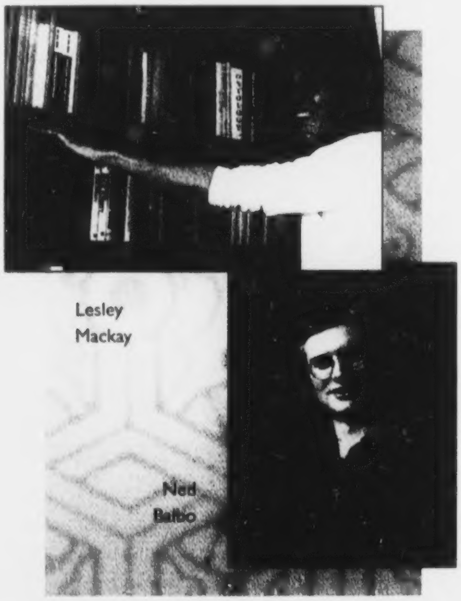
Janie and Tea Cake are supposed to be out walking in the water and the wind. Does this seem possible to you, Ned?

Ned: Hurston isn't aiming for verisimilitude, Lesley. She wants to describe an other-worldly force, one with God behind it. As the book's title suggests, the hurricane requires Hurston's characters to turn their eyes away from day-to-day life and from their struggles in order to bear witness to a force far greater than themselves. The hurricane unleashes the leveling force of nature, which for Hurston is also a divine force. Its rain and wind kill women and men, black and white, without distinction. In this pivotal event of Hurston's novel, God descends with unworldly power, and only in the aftermath of the disaster does a racist, patriarchal order begin to reassert itself.

Lesley: The terrible effects of the hurricane are all too real. We don't want to give away the ending of this powerful novel, but Hurston's conclusion does leave Janie—and the reader—bereft of the joyous sense of fulfillment for which Janie had long persevered.

Hurston's ending is decidedly not a fairy-tale one. She ends her novel of romantic and spiritual quest on a sobering note that emphasizes the essential solitude of all human beings. Her conclusion also brings Janie back to Eatonsville, where she receives a mixed reception from her old neighbors and friends. Hurston leaves Janie resuming her tenacious stand against the forces of petty judgment.

And yet, what makes this book unique is its powerful, life-affirming spirit. By the end of the novel, we understand that Janie possesses rare spiritual resources and personal strengths that will enable her to move on. ■



__Ned Balbo__ holds advanced degrees in writing from Johns Hopkins and the Iowa Writers' Workshop. He currently teaches in the Writing and Media Department at Loyola College in Maryland. __Lesley Mackay__ is IAAY's staff writer and has taught literature and composition at Indiana University.

continued from page 6

wait and apply with the regular pool. One good semester in eleventh grade is not enough to prove that you've overcome whatever deficiencies you may have had. I don't want to make a hasty decision about you one way or the other, and I won't have your first semester grades until sometime in February. If you do apply early under these circumstances, I'll probably defer you for consideration in the spring with the larger pool.

Is Hopkins' admissions process need-blind?

For the vast majority of our applicants, yes, the process is need-blind—that is, we don't take ability to pay into consideration when deciding on acceptance. But Hopkins is now in the position where 74% of our applicants apply for aid, as opposed to six or seven years ago when only 49% applied for aid. Our financial resources as an institution just can't bear that pressure.

Financial aid does become a consideration when we are at the very end of the acceptance process, and we know that we're out of resources. For the final 5%, those students who might be marginally admissible to Hopkins, we will consider ability to pay.

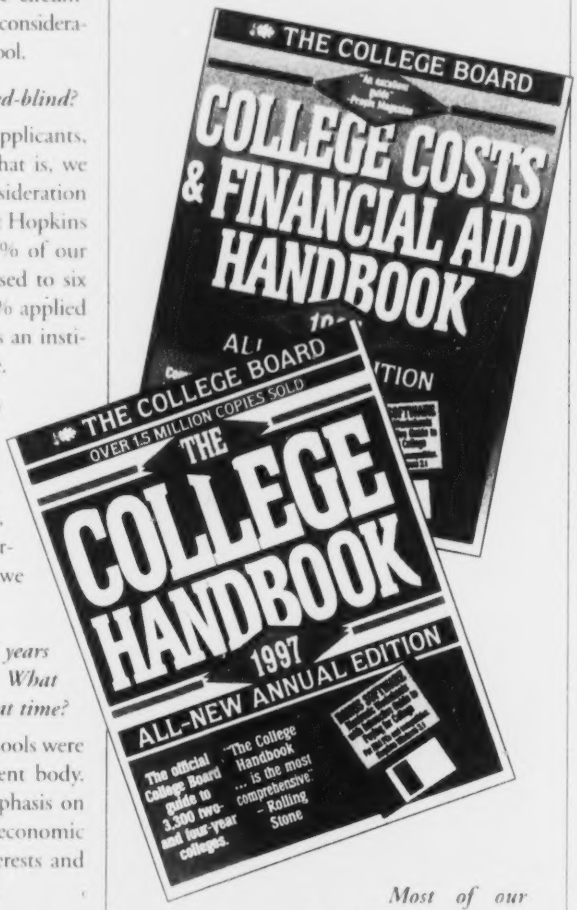
You have spent 13 of the past 17 years working in admissions offices. What trends have you noticed during that time?

Back in the '70s, only a few schools were actively recruiting a diverse student body. Now we are all placing more emphasis on diversity—not only racial and economic diversity but also diversity of interests and talents—which is all to the good.

Also, when I started in admissions back in '79, we knew very little about learning disabilities and non-standard administration of SATs. Students with learning disabilities were often penalized by many of the finest institutions, unfortunately. Now we know that such students are indeed capable.

More advanced courses are available to high school students today than when I began admissions work—which means that students for the most part are better prepared when they come to college.

Today's applicants also demonstrate increased awareness of the surrounding world and involvement in community service. When I began, it was uncommon; now you have this whole movement of secondary schools' requiring x hours of service for graduation. Of course, it was really nice when students did it purely for the intrinsic joy, but that's okay, they're certainly giving something to the community.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Most of our **Imagine** ***readers are students in seventh through twelfth grades. What can they expect in college admissions trends?***

All the demographic studies I'm aware of suggest that the applicant numbers and level of competition will continue to increase over the next few years. This year, colleges at the top end saw a dramatic increase in applications, and many of us also experienced record enrollments, much higher numbers than we had anticipated.

Why do you think that happened?

A number of factors influenced what students did this year, one being the economy. Our society is consumer oriented, and economic stress is increasing that focus. Parents want to see that their children are going to have a career, a future. They're saying, "Yes, colleges are all expensive, so if we're going to spend that kind of money, let's spend it on what we consider a top college."

So Yale filled its class without going to their waiting list; Harvard had such a response to Early Action that they accepted only a slight number—maybe 12%—of their regular pool, which is just astounding. Northwestern was close to 200 over last year's acceptances, and we've had acceptances from more than 100 students over the 915 we had expected to enroll. It's a good position to be in—as long as you can accommodate them.

Suppose I do everything right and still don't get into the college of my choice.

Some places may be more right than others for you, but that doesn't mean there's only one right place. I would hope that you did your research and put time into looking at a number of colleges, so you have back-up schools that are similar in opportunities and environment to your first choice. If you go there and make the most of that experience, you're likely to be satisfied.

And if you're not happy, we all have transfer admissions. Perhaps you weren't competitive enough as a 12th grader, but have done well in college—try again. You may apply as a transfer sophomore or junior to the same school where you were denied, without prejudice.

Any final words of advice for our readers?

When you're evaluating a college or university, remember to look beyond the "name," beyond its ranking on some published list, to the actual experience you're going to get. Take the time to learn as much as you can about different colleges and universities, about the strength of individual departments, about campus life. Planning ahead will help ensure that your undergraduate years are both intellectually and emotionally fulfilling.

STUDENTS REVIEW

CALTECH

College Review Series

This on-going series is intended to aid prospective college students in their search by offering insiders' views of selected colleges and universities, as expressed by current undergraduates or recent graduates who have exceptionally high academic ability. Note that the number of reviewers is small. Consider their personal perspectives as only one component while you gather factual information and impressions from such other sources as college catalogues, site visits, talks with officials and students on campus, and the advice of your guidance counselor and teachers.

California Institute of Technology

Our reviewers include nineteen students, who major(ed) in applied math (3), biology (1), chemistry (1), computer science (3), electrical engineering (1), math (7), and physics (6). (The number of majors exceeds nineteen because several students have double majors.) Students' comments appear within quotation marks.

Quality of Academic Instruction for Undergraduates

Reviewers agreed that both Caltech's science education and its student body are exceptional.

"Instruction is extremely fast paced and challenging. Many students have likened it to drinking from a firehose. Even if you were the top student in your high school, you'll probably find yourself ***very*** *challenged. (I got my first two* **C***s ever my first year at Caltech: one in physics and one in math, which was my* ***major****!)"*

"The academic resources (professors, grad students, other undergrads, and facilities) are among the best in the country and also among the most formidable. Caltech's core—two years of math, two years of physics, a year of chemistry, and one humanities course per term—provides a very strong and rigorous background and makes double majors or changes in major very possible. With its very low student-to-faculty ratio (about 3:1), most labs and many lectures have class sizes below 20 or even 10."

"The quality of instruction is first rate. Class size is large in core classes (the whole freshman or sophomore class), but the amount of interaction with professors and grad students more than makes up for that. Profs are extremely accessible—all it takes is a knock at their door. The core curriculum is difficult, but by no means impossible. The undergraduate labs are all outstanding and well equipped. All libraries and computer facilities are within five minutes' walking distance from the dorms, each of which also has its own small computer lab and library with frequently used reference materials."

"While most classes at Caltech are outstanding, faculty and students exhort prospective students not to come to Caltech for the classroom experience. That would be a tremendous waste of opportunity. Students should come here to get involved in research, right from freshman year. Those who do benefit from countless hours of one-on-one lessons with faculty members. Working on more challenging problems encourages one to tackle more advanced courses which no longer appear to be so academic and irrelevant."

"The coursework is hard. For everybody. I'd guess that about 97% of the students are helpful, mostly because everyone needs help at some point. I cannot overstate the fact that the atmosphere is one of cooperation rather than competition."

"The importance of the Caltech Honor Code can't be overemphasized: 'No member of the Caltech community shall ever take unfair advantage over another member of the Caltech community.' Sounds simple, but in contrast to what I've heard of other schools' honor systems, it works. Because of it, the vast majority of examinations are take-home and can be scheduled at leisure."

"One caveat: most of the professors are brilliant, but because there aren't as many of them as at some larger schools, the opportunites can be spotty. Check first to make sure there's a professor in your particular area of interest."

Social Life

All reviewers enjoy Caltech's collegial social atmosphere and out-of-the-ordinary student body. The male-to-female ratio (3:1) and heavy workload do, however, take a toll on the social life.

"The stereotype is that Caltech has no social life, but that's untrue. It is simply a different kind of social life. Imagine being among the smartest, strangest people in the U.S. (kind of like the movie 'Real Genius' but less exaggerated), and you've got Caltech. The 'strangeness' of the students manifests itself with really great pranks (especially while a frosh), the most famous of which is the switching of the 'Hollywood' sign with a 'Caltech' sign."

"Caltech is a socially quirky place, and the first few years can keep one pretty amused just jiving with the quirks. Dropping a liquid-nitrogen-frozen pumpkin from the top of the nine-story Millikan Library on Halloween is quite exciting the first time."

"Most social life centers around the seven Houses in which most students live. They resemble a cross between dorms and frats without any emphasis on drinking. (It's difficult to drink much and do all the work.) Each has its own distinctive personality, from '60s-ish to conservative, from comparatively frat-like to more dorm-like. One House is renowned for its steam tunnel explorers and incredible frosh construction projects. House spirit really runs rampant; alumni stick together long after graduation."

"The social life is relaxed. People tend to chat, play games, or have low-key parties. It doesn't sound exciting, but it's really very enjoyable. The intense workload does adversely impact the social life; however, the students are in general very friendly, and we manage to fit in plenty of socializing, helped by the heavily cooperative study habits here."

"Dating can be summed up in one word: miserable. The male-to-female ratio is 3:1. This means that if you're male, you're less likely to find a girlfriend than at other schools; if you're female, expect a lot of unwanted attention."

"So far, I have not been involved in any of the social life, but I know it exists and I might check it out if I have time."

What Do You Like Best about Caltech?

No surprises here: the science and the people.

"Nowhere else are so many people having so much fun with science. The school revolves

around science, from the core curriculum to SURFs (Summer Undergraduate Research Fellowships) to readily available research opportunities during the academic year to (most importantly) the people. A freshman can ask almost any other undergrad for help on calculus, physics, or chemistry."

"The people. Caltech students are brighter and more creative than those at any other school I visited. Here, the rules of reality are suspended. You can walk past a dorm room, see a baleful-looking machine sparking away, and inquire to find that they're splicing into the main power line to make buckyballs. You can wake up in the morning to the sound of explosions and the smell of orange juice, and run into the courtyard to see a Dabney House liquid-nitrogen-powered cannon firing oranges at Fleming House."

"It is a two-way tie between getting the best possible education in the U.S. and living among people who are strange, but in a good way. At Caltech I was amazed on an almost daily basis. Caltech is marvelously magic—you come out of it with a faith that you can do miracles if you just organize well enough. (Which is true.)"

"The Honor Code governs **all** *aspects of student life (not just academics). This commitment to mutual trust really contributes to the student experience—you learn a lot about the concept of 'honor' as opposed to 'following the rules.' It gives you a real standard to live up to. And by and large, the students do."*

"Because of the Honor Code, every student is trusted not only in taking tests but also in using expensive scientific equipment. You can tinker around with the computers and the meters in the labs. This kind of learning works a lot better for me than do lectures or homework sets."

What Do You Like Least about Caltech?

Reviewers differed in their assessments of just how intense the pressure and the workload are.

"The stress is incredible. The 'flame' rate (being put on psychiatric or academic leave) is high, as students accustomed to being at the top of their class find themselves at the bottom for the first time. Caltech can be very hard on you; it tends to grind down your academic self-image at the same time that your social self-image is taking a beating (because of the ratio)."

"In retrospect, there was very little I disliked. Yes, at times the workload was crushingly difficult, but that's the point. Perhaps some of the teaching could profitably have been improved upon, but I'm really kind of grasping here."

"Sometimes I miss the aspects of undergraduate education I didn't get there. Caltechers soak up information, and those who want to be well rounded will end up being so. For example, I'm now reading a lot of history, and in some ways, this ex post facto self-study approach suits me fine. But I miss the conversational side of such learning I might have had at a non-tech school."

CALIFORNIA INSTITUTE OF TECHNOLOGY

Pasadena, CA 91125
(818) 395-6341

- 4-year private coed university
- Campus in a suburb of Los Angeles
- Full-time undergraduate enrollment 1995-96: 695 men; 228 women
- Special features: Honor code; Summer Undergraduate Research Fellowships. Caltech manages the nearby 6,200-person Jet Propulsion Laboratory for NASA.

Who Would Be Most Compatible with the Academic and Social Atmosphere at Caltech?

"If you're the type who will (a) apply to Caltech and (b) get accepted, you'll probably fit in just fine. If not, well, you're probably not considering Caltech anyway. The majority of people here were tops in their class, and being here has certainly humbled them. If you haven't learned to deal with failure before you come, you will by the time you get through, and be better for it."

"Someone who is very bright, very focused on the sciences (and **well** *prepared to study them), and who enjoys neat new technotoys enough to endure the pressure. (Don't come here to major in literature unless you want to write sci-fi novels.) I would* **strongly** *recommend visiting Caltech before coming here. If the company of mad geniuses appeals to you, then Caltech is very much the place for you. If you have any doubts, I would recommend against it. Interests other than science are valued and can be exercised here, but you should be prepared to relegate them to a distant second place in priority."*

"Someone who is willing to give four years of his or her life to learning science at a breakneck pace is **perhaps** *ready for Caltech."*

If You Had It to Do over Again, Would You Go to Caltech?

Most reviewers emphatically said yes; a few were cautious in their endorsements.

"Definitely. In fact, I can't believe I even considered attending another school, now that I realize what I would have missed. I've found the best professors, the best students, and the best toys to play with."

"Unquestionably. On educational merit, the list of alternatives to Caltech is very short."

"Absolutely. Caltech had its drawbacks, but it challenged me to the limits of my ability. Being with students full of enthusiasm for their majors and inquisitive/critical about virtually any topic really brought me a lot of joy. Even more importantly, Caltech inculcated a belief that there is no such thing as 'too much effort' for something you want to do, and that learning is **fun**, *not just something you do for classes."*

"I have thought about this a lot at times, and I do not know. Do not take this as a negative response. Being accepted is a little like having a seat on Apollo 8. Sure, you might die trapped in a permanent lunar orbit, but how can you spend the rest of your life knowing that you could have gone and did not try it? I felt that way when I decided to go to Caltech, and I would feel the same way about a similar opportunity today."

As you try to find the college or university best suited to you, the views of Caltech presented above may be helpful. Keep in mind that these students might have had similar positive or negative experiences had they attended a different university. At any college, it is important to seek out challenging academic experiences and the best professors and to create a social life that fits your personal style. ■

Note: The students quoted in the College Review Series are expressing their own views, which are not necessarily those of JHU or IAAY.

CREATIVE MINDS

ImaGiNe...

Submit your creative work—brain teasers, short stories/essays/book reviews. We look forward to hearing from you. Please write to Imagine • SET at IAAY • The Johns Hopkins University • Baltimore, MD 21218

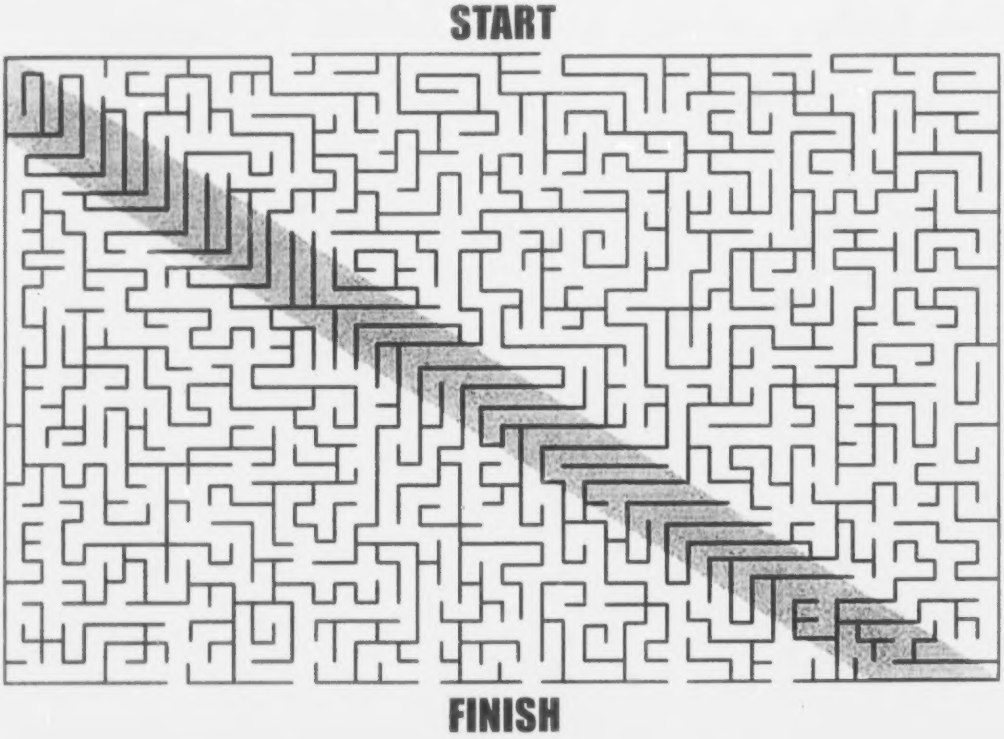
Thirteen-year-old ***Tenie Remmel*** *lives in Seattle, Washington, and is being home-schooled. He is studying college-level mathematics and science, enjoys computer programming, and is working on a packet of games for publication. Tenie also participates in gymnastics and competes on a swim team.*

PUZZLE

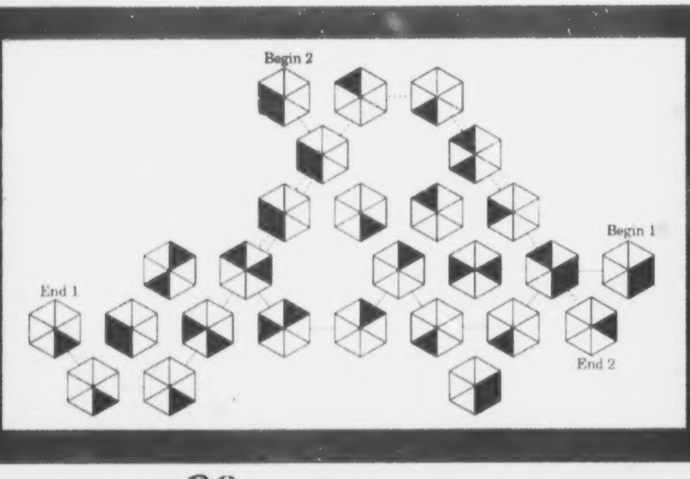
by Tenie Remmel

Directions:

Find your way from Start to Finish without crossing any lines while crossing the gray strip exactly three times. Do not retrace your steps or make loops. You may not exit and re-enter the puzzle.



Solution to Another Puzzle by Tim Boester in May/June 1996 issue of *Imagine*



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Spotlight On

INVESTIGATING THE PAST THROUGH HISTORY AND ARCHAEOLOGY

"Hey Jackie, Can You Take It?" During the 1996 National History Day competition, Horace Mann Middle School students from Denver, Colorado, recall Jackie Robinson's entry into major league baseball.

In kaleidoscopic richness, the past is always with us. History's narratives span the past, while forging connections with the present and even the future. As Robert Warren writes in an account of his National History Day project, "History is by no means a dead subject. Its lessons inform us and, more importantly, teach us who we are and what we can be."

Who we are and what we can be … this theme runs through our diverse array of articles on investigating history and archaeology: A graduate student describes her search for vestiges of ancient cultures at an archaeological dig in Turkey. A Harvard senior introduces us to his exciting field, evolutionary biology. One of our staff writers explores the U.S. Holocaust Memorial Museum and its powerful evocation of this genocide. And student writers provide their own perspectives as museum interns, historical dramatists, and commentators.

You'll also find our usual abundance of additional features. Be sure to dive into our career profile of computer scientists who design cutting-edge software for virtual reality. And check out the first in our new series designed to help you plan and prepare for college. We hope you have fun exploring *Imagine.* ■

Published by the Johns Hopkins University Press for the JHU Institute for the Academic Advancement of Youth

MARK YOUR CALENDAR

with these registration deadlines for selected academic competitions. Inquire about competition format, dates, and fees.

DEADLINE	COMPETITION
Fall 1996	**JETS–TEAMS Competition, and National Engineering Design Challenge**—Schools register varsity and jr. varsity teams for both competitions, grades 9–12; *call for state deadlines.* Junior Engineering Technical Society, 1420 King Street, Suite 405, Alexandria, VA 22314-2794; (703) 548-5387, fax (703) 548-0769, jets@nas.edu; http://www.asee.org/jets
December 1*	**U.S. Academic Triathlon**—Schools or organizations register teams, grades 5–8; enrichment materials available for grades 3–4. *December 1 deadline for existing teams in AZ, KS, MN, NY; new teams in any state may register through May 1: Peggy Sheldon, University of St. Thomas, DUN 234, Minneapolis, MN 55403; (612) 962-4534, fax (612) 962-4810; psheldon@stthomas.edu
January 6	**USA Computing Olympiad**—School coordinators register grades 9–12; Qualifying Round held late January: Dr. Donald T. Piele, University of Wisconsin-Parkside, Kenosha, WI 53141; (414) 595-2231; http://usaco.uwp.edu
January 6 & March 3	**Knowledge Master Open-Elementary**—Schools enter one team, grades 5 & 6: Academic Hallmarks, Box 998, Durango, CO 81302; (800) 321-9218; fax (970) 247-0997. (*Grades 7–12 register by March 31.*)
January 10	**National Latin Exam**—Latin teachers register student in Latin I–V: National Latin Exam, P.O. Box 95, Mount Vernon, VA 22121; format questions, (703) 360-4354; delivery/awards questions, (703) 455-6779.
January 15	**Duracell/NSTA Scholarship Competition**—Students enter individual original projects, grades 9–12: National Science Teachers Association, 1840 Wilson Boulevard, Arlington, VA 22201-3000; (703) 312-9201.
January 23	**NCTE Achievement Awards in Writing**—Teachers nominate students in grade 11: National Council of Teachers of English, Achievement Awards in Writing, 1111 W. Kenyon Road, Urbana, IL 61801-1096; (217) 328-3870.
February 3	**Toshiba/NSTA ExploraVision Awards Program**—Teachers and community advisors register student teams, grades K–3, 4–6, 7–9, 10–12: National Science Teachers Association, 1840 Wilson Boulevard, Arlington, VA 22201-3000; (800) EXPLOR 9 or (703) 243-7100; http://www.nsta.org/programs/explora.htm
February 5	**Quill & Scroll Society International Writing and Photography Contest**—Individual enter, grades 7–12: School of Journalism, University of Iowa, Iowa City, IA 52242; (319) 335-5795, fax (319) 335-5210.
February 7	**National Peace Essay Contest**—Students enter with adult contest coordinator, grades 9–12: United States Institute of Peace, 1550 M Street, NW, Suite 700, Washington, DC 20005-1708; (202) 429-3846; heather_kerr@usip.org

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Correction to "Going Public" in September/October issue: St. Mary's College of Maryland is a state-supported college but is not part of the University of Maryland system.

Want to subscribe to *Imagine?* Call (410) 516-6989 or (800) 548-1784 and ask about our introductory price.

COMING ATTRACTIONS: *Imagine*'s January/February 1997 issue will focus on Exploring the Universe through Physics and Astronomy. Contents will include a career interview with Dr. JoBea Way at NASA's Jet Propulsion Laboratory and a student review of the University of Chicago.

Imagine...
*Opportunities and Resources for Academically Talented Youth**

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WHY STUDY HISTORY?

A FUTURE HISTORIAN MAKES THE CASE FOR ALL OF US

by Darcy R. Fryer

The most difficult moment of my graduate school application process was when I sat down to write an essay explaining why I wanted to be a historian. I have loved history for as long as I can remember, but had never tried to justify my love of the past. Now, as I sought to do so, reasons eluded me. History is not an obviously useful discipline like engineering or psychology, and it has a reputation for being dry, arcane, and difficult. Why would I or anyone else feel called to study it?

History Shapes Us ...

When I was a child I tried to imagine what my life might have been like in another time and place: in ancient Rome, as a Pilgrim, on the 19th-century American frontier. In elaborate daydreams I tried to figure out which aspects of my personality were fundamental to my nature and which were merely a result of my historical and cultural circumstances. Gradually I began to question how other people—both relatives and historical figures—had been shaped by their times.

Some of my best teachers cultivated this curiosity with imaginative assignments. My 10th-grade world history teacher required the class to reenact the trial of Louis XVI (I almost got him off). A college professor asked on a final exam, "How might the story of *Beowulf* have been told if it had been written by the author of the *Song of Roland*?"

By forcing us to ask questions like these, by broadening our vision and deepening our sympathies, history serves one of its finest purposes. It is easy to condemn mistakes that others have committed in the past. But it is also true that, when we immerse ourselves in a historical moment, we acquire a sense of the times, of the limited information and different assumptions with which others worked.

This does not excuse immoral or evil acts, but it can provoke a critically important question: what would I have done in that historical circumstance? And in cases of evil, the world collectively must ask: how can we prevent this from happening again?

... And We Shape History

History also teaches us how easily the world might have been different. Decisions that seemed trivial at the time sometimes have momentous consequences.

For example, when the British Parliament repealed most of the Townshend duties in 1770 but decided to retain the tax on tea, did anyone imagine that tea—a brand new luxury import, the espresso of the 18th century—would become a lightning rod of the American Revolution, the means of politicizing artisans and laborers? Suppose the British lawmakers hadn't played favorites with the East India Company. They would probably still have lost the colonies, but the opening acts of the War of Independence might have been quite different.

The Rich Rewards of Studying the Past

In their work, philosophers love to pose conundrums with neatly balanced and equally unappealing courses of action. History poses the same knotty dilemmas—they turn up in learned monographs as often as they do on television—elaborated with more detail, more options, and more vexing complications.

The past unfurls as a panorama of countless variations on a few basic human themes: work, war, love, death, survival, migration. Most of us encounter these themes in our own lives and must decide how to meet their challenges. History reveals how others have met them and dares us to consider what they might have done differently.

That, in the last analysis, is why I believe history is worth studying. It is complex, confusing, enthralling, ironic, mysterious, and true—the perfect vehicle for encouraging people to analyze human problems. This is a skill that is useful not only to historians but also to politicians, administrators, businessmen and women, neighbors, parents, friends—in fact, to everyone.

Only a handful of people want to be professional historians who grapple full-time with our biggest questions about the past: Why did Christianity catch on? Did racism breed slavery, or did slavery create racism? Where did capitalism come from? But sooner or later, everyone wonders why something happened—why his family has the traditions it does, why her company follows a policy that she finds irrational, why a particular law is on the books.

A person who has learned to trace the development of one historical problem can go on to trace another. And each new strand of knowledge enriches our understanding of how the world got to be the way it is, of the contours of cultural fossil and sediment that support our present life, and of how we can shape the future. ■

With a B.A. in History from the University of Michigan, ***Darcy Fryer*** *is now in her second year of graduate study in the History Department at Yale University. She specializes in the American colonial period.*

The Concord Review: A Quarterly Review of Essays by Students of History publishes research papers by 9th–12th graders on historical topics of national and international interest. *The Concord Review* also sponsors the Emerson Prize in History. If you would like to learn more about this excellent publication, see the home page: http://www.tcr.org

Will Fitzhugh, The Concord Review, P.O. Box 661, concord, MA 01742; (508) 443-0022.

National History Day

PROMOTING THE STUDY OF HISTORY IN THE SCHOOLS

Voice of the Voiceless

by Robert James Warren

"Good afternoon. My name is Robert James Warren, and the title of my performance is 'Voice of the Voiceless.'" With those words, I close my eyes and bow my head. My vision blurs, my head swims, and my pulse races—but only for a moment. Then my head comes up, and once again I'm calm, in control, and (I hope) in character. In this case, I'm the late Archbishop Oscar Arnulfo Romero, who was assassinated for his defense of the oppressed poor in El Salvador....

Welcome to the National History Day competition. Each year, scenes like this one are played out in hundreds of classrooms across the country. In a sense, this competition is social studies' answer to the science fair. Students have an opportunity to conduct outside research on a historical topic that interests them, to synthesize the knowledge and skills they have acquired, and to present the results in a variety of coherent and appealing ways.

I've always had a great love of the theater, and the performance category has offered me a wonderful chance to blend drama with history. In 8th grade, I portrayed Moses Rose, a French fur trader who was the sole survivor of the Battle of the Alamo. In 9th grade, I chose Cardinal Pelagius de Santa Lucia, papal legate to the Crusaders during the Fifth Crusade, whose arrogance and constant blunders caused that mission to fail miserably. This past year, my project focused on the slain Archbishop Romero.

I first became interested in this martyred prelate in 8th grade when I saw *Romero*, the movie that detailed his life. I was moved by Raul Julia's portrayal of the archbishop. Especially powerful was his depiction of the sermon Romero gave on March 23, 1980—a sermon that is thought to have sealed his death warrant.

Romero was willing to take a stand and fearlessly speak out against the violence and oppression that ran rampant in his country, small and war-torn El Salvador. He was assassinated by the military for his defense of the *campesinos*, poor Indian and mestizo peasants, and for his support of the left-wing popular groups that were trying to reform and in some cases defy the existing government. Romero's legacy of faith and hope for the liberation of his people lives on in the Salvadoran people, many of whom regard him as a saint and honor him as a prophet and a martyr.

Robert James Warren's dramatic presentation about Romero was recognized at National History Day as the best senior entry from Georgia. Robert is an 11th grader at Northside HighSchool in Warner Robins, Georgia. His interests include debate, singing, and chess.

When I discovered that the theme for the 1995-96 National History Day was "Taking a Stand in History," I became excited. I researched Romero and Liberation Theology—the Church philosophy he advocated—in my school and public libraries and in back issues of religious magazines. Then I sketched out how I wanted to present the information I'd gathered. I experimented with several narrators, finally deciding that my performance would shift back and forth between two dramatic monologues: one spoken in the voice of Romero and one in the voice of an ordinary priest. I planned to wear the same priest's robe for the entire performance, but change my speech and facial expressions to fit my sense of each character.

Curiously, I was doing something unrelated to the competition when the finishing touch for my History Day project came to me in a flash of insight. When reading the Bible one day, I noticed that each of the Beatitudes in the Sermon on the Mount matched—by a stroke of luck—with a different part of my project. I decided to introduce the theme of each part by singing one of the Beatitudes from an old Church song, "We Are the Light of the World."

Today, sixteen years after his assassination, Romero's willingness to take a stand against injustice and oppression inspires people throughout Latin America and beyond. Studying his life and his words, so often filled with the conviction that we can all do something, at least have a sense of understanding, made me reflect on how I can show compassion for those around me in my daily life. History is by no means a dead subject. The lessons it teaches make us more informed and, more importantly, teach us who we are and what we can be.

... And so I've come to the end of my performance, which I have come to know so well: "The people of El Salvador continue to hear Romero's voice, 'Corragio! Lift up your spirit, have courage.'" To this might well be added, "And dare to learn." ■

National History Day

Annually, over 500,000 middle and high school students offer projects, media presentations, performances, and historical papers in History Day competitions. National History Day finals take place at the University of Maryland; prizes include a $60,000 full tuition scholarship to Case Western Reserve University and three $5,000 scholarships sponsored by The History Channel. The 1996-97 theme is "Triumph and Tragedy in History."

The National History Day office offers teaching materials and sponsors workshops and summer institutes for history/social studies teachers.

For more information:
Dr. Cathy Gorn, National History Day, 0119 Cecil Hall, University of Maryland, College Park, MD 20742; (301) 314-9739, fax (301) 314-9767; hstryday@aol.com; http://www.inform.umd.edu/NHD

The White Rose

by Jessica Stites

For our History Day project, three friends and I prepared a ten-minute video on the World War II German Resistance group called the White Rose. The members of the White Rose, all students at the University of Munich, adopted a principled stand against Hitler's Nazi regime. The students protested Hitler's policies by writing pamphlets and distributing them throughout Munich and neighboring towns. They exposed Hitler's censorship of books and ideas, as well as his policies of genocide. For this, the White Rose leaders were arrested and executed.

Ten minutes was not a lot of time for a presentation about these courageous young people, whom my friends and I admired so much. Originally, our project was going to be a slide show. We wrote the script and organized the slides with confidence that our research and visuals were solid. Unfortunately, though, we soon ran into major setbacks. Many of our slides were scratchy or fuzzy. The tape of our script—having suffered countless revisions, copies, and microphone problems—sounded like a cat wailing.

Just when we were about to give in to frustration, one of us suggested, "Why don't we switch our category to video-making? At Charter Communications, they'll let us work free, and they'll air our video…." That idea was all the start we needed. We immediately scheduled work dates at the local cable company. For almost two weeks, we lived and breathed video-making. In the process, we learned how to do a lot of cool things we had never known existed: jogging, fading, marking in and out, scrolling, and other obscure techniques. I loved it.

After a final hour of feverish work, we had a video entitled "*Die Weisse Rose*: Students against Hitler." We watched in pride and awe as a German scene appeared on the screen and a voice said, "September 1938, Nazi Germany. The powerful words of Hitler have swept the nation …"

All we had left to do was to face the competition. As our video played, we watched the judges, hoping for a sign. We read omens in everything—in the length of the judges' faces as they conferred, in their pauses as they read out the names of the winners in other categories. The four of us sat with clenched hands and crossed fingers; as they announced each award, we tensed, then relaxed when we realized it wasn't our category.

Suddenly we heard, "*Die Weisse Rose*, third place, Group Media Division." We hugged each other, knowing that we had made an impact with our project and that all our efforts had been worthwhile. ■

Ninth grader ***Jessica Stites*** *attends E.O. Smith High School in Mansfield, Connecticut. She enjoys art, writing poetry, and listening to music. Jessica plans to be a freelance writer.*

Protests at Kent State

by Maria Aspan

In my school, all 7th and 8th graders work for a semester on a History Day project. We choose a topic, research it for 4 ½ months using a minimum of 20 sources, and present it with a short paper and annotated bibliography. The best entries are refined for regional competition.

With last year's overall theme, "Taking a Stand in History," being so broad, I wanted to choose a topic that few if any of my classmates would pick, something other than a war or an aspect of the civil rights movement. I discarded many ideas before I thought of the Vietnam war protests held at Kent State University in May 1970.

When the government announced that the U.S. had invaded Cambodia, students burned Kent State's ROTC building. The National Guard was called out, and tension between students and the Guard escalated during two days of rallies. On the third day, after ordering protesters at a noon rally to disperse, National Guardsmen shot into the crowd, killing four students and injuring nine others.

Once I had determined my topic, the research was not difficult. I read or skimmed a number of books. I went to local college libraries and found many of my primary sources in old news articles on microfilm. I also obtained information from the May 4 Memorial Center at Kent State University.

When it came time to choose a mode of presentation, I had few doubts about doing an individual performance; this category had won me second place at the regionals the previous year. After pondering how to convey the different emotions and purposes present at the protest, I decided (with my teacher's help) to assume three different identities: a narrator, a student, and a guardsman. The narrator handled most of the exposition; both the student and guardsman reacted to the events and offered commentary based on their conflicting viewpoints.

My costume and props were relatively simple. I dressed in solid black as the narrator, put on a vest as the student, and wore a camouflage cap as the guardsman. I had a coat tree to hang the cap and vest on and a bench to dive behind when my student character was "shot" at.

I polished my performance to the point that people told me they jumped in their seats when I reacted to the "gunshots." I won first place in the regionals, then went to Penn State University for the state level, happy and confident. Then, because my last name is at the beginning of the alphabet, I was assigned the first time slot in a two-day period of competition. Although I did not place, I returned from Penn State satisfied with my performance and very well-informed about an event I had only vaguely heard about before. ■

Fourteen-year-old ***Maria Aspan*** *enjoys writing as well as competing in math contests and speech tournaments. She is a 9th grader at Notre Dame Academy in Philadelphia.*

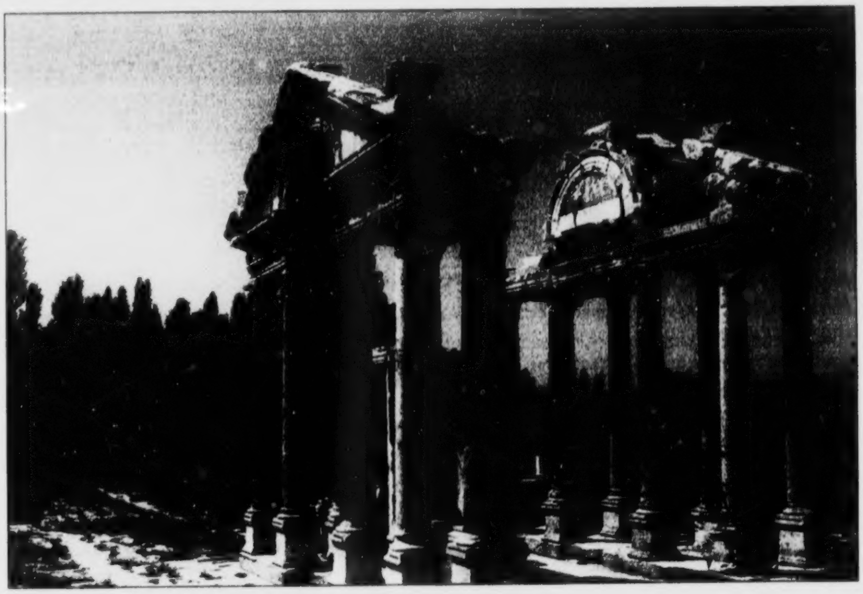
POTSHERDS AND EMERALDS

Portrait of a Young Archaeologist

by Lisa Brody

Remnants of buildings, broken pieces of pottery, bits of tools and cooking utensils, fragments of sculpture—such artifacts can reveal much about the people who created, used, and eventually left them behind. By closely examining these puzzle pieces, archaeologists painstakingly reconstruct the daily lives and beliefs of past cultures.

Probing the mysteries of the past is the exciting part of being an archaeologist, but the thrill-a-minute experiences of Indiana Jones are fiction. As any excavator can tell you, the exhilaration of unearthing a special find is followed by hours of more prosaic tasks such as cleaning and analyzing artifacts and recording data. Yet these mundane activities are essential to reaching a valid understanding of the past. Proper handling of a find can bring a distant culture close enough to touch. Literally.



Tetrapylon Aphrodisias, Turkey

TOWARD A FUTURE IN THE PAST

My love of archaeology has its roots in my childhood. I unearthed anything I could find in the sand at the beach and gathered "collections" of almost everything: stamps, coins, fossils, bottlecaps. I loved viewing museum exhibitions and touring reconstructed historical sites, enjoyed reading mysteries and solving puzzles.

My first archaeological adventure came the summer after 8th grade when CTY's Archaeology course exposed me to fieldwork and methodological techniques. More formal course work came one summer during high school when I studied archaeological field techniques at Harvard. This provided my first real opportunity to get my hands dirty as we excavated one of the university's first buildings, long since demolished.

Also during high school, I volunteered with a group of National Park Service archaeologists, excavating at a colonial mansion near Washington, D.C., and doing related lab work. My study of pipestems recovered there helped them estimate the date of the site and earned me a footnote citation in a published paper. I was *thrilled.*

My archaeological studies really took off at Yale, one of the few universities with an undergraduate major in this field. Theirs is an interdisciplinary program that combines the departments of Anthropology, Art History, Classics, Near Eastern Studies, and Geology. Unsure about an area of specialization, I studied a range of regions and periods—from Egyptian to Meso-American and from prehistoric to colonial. My summers took me to digs in Maryland and Portugal. Then, in my junior year, my long-standing love of Greco-Roman art and mythology drew me to specialize in classical archaeology.

For my senior thesis, I used the model of my Harvard summer course to organize a dig on the Yale campus. This project involved getting permission from Yale's president (granted on the condition that the lawn be replaced to the satisfaction of the Department of Buildings and Grounds), finding volunteers to help dig, and dealing with crowds of curious spectators. We unearthed the foundation of an original building in Yale's Old Brick Row, along with miscellaneous artifacts—including more pipestems. My final paper was published in the *Bulletin of the Connecticut Society of Archaeology.*

Most classical archaeologists become university professors who excavate during the summers. Planning to follow in this path, I enrolled in a Ph.D. program at the Institute of Fine Arts, New York University's graduate department of art history and archaeology. After four years of graduate course work and a year studying in Greece, I'm now writing my dissertation.

I've spent recent summers excavating in Turkey at Aphrodisias, a Roman city that flourished from the first century B.C. to the fifth century A.D. Aphrodisias is one of the Mediterranean's best preserved ancient sites, with beautiful sculpture and buildings that include a temple, theater, stadium, and public bath—all the basic features of a Roman town. Remnants at the site also indicate the influence of Early Anatolian, Greek, and Early Christian cultures.

A DAY AT APHRODISIAS: 3 AUGUST 1996

6:15 am: Wake up, brush teeth, pull on shorts and t-shirt. I'll get so dirty out in the field, there's no point in showering until the end of the day. Breakfast at the site consists of fresh bread from the nearby village, sour cherry jam (a Turkish specialty), cheese, olives, yogurt, and sometimes corn flakes. Tea and instant coffee help everyone get moving.

7:00 am: Work begins. I'm digging along one edge of the Roman Agora, or main city marketplace. I supervise four Turkish workmen who do much of the manual labor, but I enjoy getting down in the trench to dig, too. I really like my team of workmen, and my Turkish has become quite good since I started working here. Even so, communication can sometimes get difficult. But today when I ask Mustafa to find another wheelbarrow, he understands me right away.

I'm starting to feel at home in my trench. After weeks of careful digging and writing descriptions of all the layers, we're now excavating the foundations of the Roman marketplace. For a short while, we stop digging and clean the trench in order to take a series of photographs. I laugh for a minute at this activity—how silly it seems to be sweeping a dirt floor. But the photos will be critical both for studying and understanding the architecture and for future publication.

9:00 am: Break for tea and cookies. The nourishment is welcome; we use a lot of energy working out in the field. This is also a good time to consult with the field director and talk to the other excavators about their finds. One is supervising a trench in the stadium, which is one of the biggest, best-preserved, and most impressive of its kind in the world. There, my colleague hopes to find the racetrack's starting line.

12:00 noon: Lunch. Much of the team uses the break to nap. The weather is hot, often reaching 110° in the shade, although the humidity is low. Today I'm going to spend this time in the library, entering records of the artifacts we've found into our computer database.

3:00 pm: Back to work. This afternoon we continue to uncover more of the foundation to see how it was actually constructed. Underneath the column that had remained standing in place, we find several courses of marble blocks and a rubble sub-foundation. I'll sketch the stones, and tomorrow morning the photographer will come out to take pictures.

By late afternoon, I'm sweaty and covered with dirt. I don't think I'll get all the dirt out from under my fingernails until at least a month after the season is over. But today has been fun—like playing in the dirt when I was a kid.

6:00 pm: The whistle blows, and the workmen head home. Wearily, I head back to the dig house for more tea. Work is not over yet; there's lots to do after hours, especially at the end of the season. Each excavator must sort and record all artifacts he or she has found and eventually write a comprehensive account. This work will contribute to the overall site report, published each January in the *American Journal of Archaeology*.

Not every evening is taken up by work, however. Tonight, we play an impromptu game of soccer (our European colleagues call it football). On other evenings, I go running around the site, or a few of us do step aerobic classes—using wooden finds-boxes as steps.

9:00 pm: Dinner. Time to catch up with the rest of the team, which includes art historians, architects, and conservators. These people did not spend the day in the trenches, but worked in the museum, storage depots, architects' studio, and conservation labs. Archaeology is basically a destructive process; once something is dug up, it begins to deteriorate. So the efforts of everyone involved in post-excavation work are at least as important as the digging itself.

After dinner, there's time either to work or to relax. Tonight, I play a few hands of cards. Then, it's off to bed. I need to be alert when the whistle blows tomorrow morning.

POSTSCRIPT

This summer, my team of excavators located the foundation of the portico of the Agora, contributing to our understanding of the overall city plan of Aphrodisias. Much of the city has yet to be excavated, and we expect work at Aphrodisias to continue for many years—pending funding, of course.

Archaeology allows us to know and understand past civilizations, and through that knowledge we gain a greater appreciation of the cultural heritages of people today. When I leave for a dig, my friends at home tease me, saying, "No potsherds! Find emeralds!" Well, I haven't found any emeralds. But every find—from gold masks and silver vases to the smallest fragment of unglazed pottery—has potential significance: the power to unlock the past. ■

Lisa Brody *will spend this academic year at the American School of Classical Studies in Athens, Greece. She will be researching and writing her dissertation, which will focus on the cult statue Aphrodite of Aphrodisias.*

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FROM JAWBONES TO GENOMES

THE HISTORY OF A SCIENCE

by Scott Rifkin

How does one study really ancient history? Creative scientists have used a diverse array of technical and conceptual approaches to try to glimpse the dawn of humankind. In this essay, a student looks back on the past and into the future of his chosen discipline, evolutionary biology.

In 1925, the same year that John Scopes stood trial in Tennessee for teaching evolution in public schools, Australian anatomist Raymond Dart described a skull found in the Taung lime quarry near Johannesburg, South Africa. The skull was small, a juvenile's, with an ape-like face. But a cast of the inside of the skull suggested an unexpectedly human-like brain. Dart saw evidence of brain structures that apes do not possess but that could have represented a step toward similar structures in modern human brains. He excitedly rushed a manuscript to the journal *Nature*, announcing the discovery of *Australopithecus africanus*, one of the first "missing links" between humans and apes ever to be found.

"Taung child" skull. From THE FOSSIL TRAIL by Ian Tattersall.
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Dart is one of many explorers who have used scientific approaches to try to reconstruct our most ancient past. Evolutionary biology has been built by such individuals—astute enough to see suggestive details or trends in often very fragmentary data, and bold enough to go public with their speculations.

ORIGINS OF A SCIENCE

Evolutionary biology is a synthetic discipline, encompassing a number of subfields with a common focus on the history of life. It was born as a modern science in the mid-1800s amidst a growing awareness that living forms change not only over a lifetime—development—but also over longer stretches of time—evolution. The refinement of sophisticated techniques for comparing the bones and body parts of animals accelerated the accumulation of evidence of such change.

In 1859, Charles Darwin shook the world with the publication of *On the Origin of Species*, in which he laid out a framework for understanding the history of life. His theory of natural selection rests upon the fact that members of a population vary, and part of that variation is heritable. Different parents have different numbers of offspring, each of which possesses a unique set of characteristics.

Darwin realized that, since not all offspring will survive to reproduce, only some heritable traits will be passed to the next generation. Small changes will accumulate over many generations until descendants look quite different from their ancestors. By framing evolution in these terms, Darwin proposed a theoretical model for understanding why populations change over time.

Another idea that shaped evolutionary biology developed concurrently, not in the bustling intellectual community in which Darwin's ideas were hotly debated but in a secluded Moravian monastery. There, Gregor Mendel worked out the basic principles of genetic inheritance by breeding and studying generations of pea plants. Not until decades after his death did Mendel's discoveries become a pillar of modern biology.

Thus, Darwin developed his theory of natural selection entirely without the benefit of the concept of genes. Only in the 1920s did evolutionary biology finally emerge as a coherent discipline, melding Darwin's and Mendel's ideas into a larger framework that incorporated comparative anatomy, paleontology, natural history, and genetics.

ANATOMY LESSONS

Throughout most of evolutionary biology's history, the main evidence for evolution has come from comparative studies of living organisms, like Darwin's studies of birds, and from similar analyses of the fossil record. Comparative anatomists and paleontologists became ingenious at inferring characteristics about organisms from their anatomical structure.

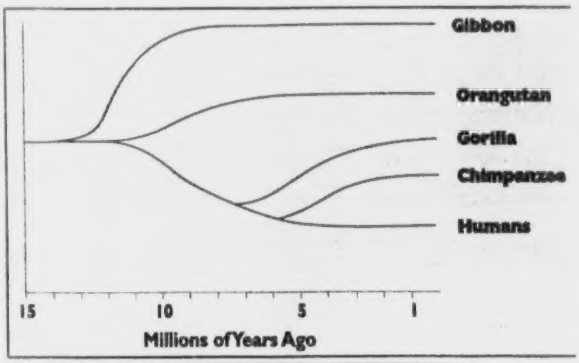
An animal's gait, for example, is governed by such features as the relative lengths of its upper and lower limbs, the shape of its pelvis, and the points where its muscles attach to its leg bones. Its running speed and power can be estimated using the principles of mechanics. Using these and other anatomical data (e.g., of structures of the jaw and teeth), one can speculate about how and what an animal ate, what role it may have played in the food chain, even how the species' social system worked. (This process was engagingly dramatized in *Jurassic Park* when a paleontologist described the probable lifestyles of various dinosaurs on the basis of skeletal remains.)

However, there is sometimes a fine line between well-informed and fanciful hypothesizing. A famous misinterpretation was made in 1961 when paleontologist Elwyn Simons "reconstructed" an early primate on the basis of a single broken upper jawbone. Proposing that 15-million-year-old *Ramapithecus* represented the first hominid, Simons constructed a whole life history for the primate, claiming it was bipedal, made tools, was social, and hunted. For fifteen years he continued to develop his theory, incorporating favorable new evidence and rebuffing challenges. Finally, newer data invalidated his hypothesis. *Ramapithecus* is now thought to be an early relative of the orangutan.

THE STORIES GENES TELL

Genes are the biological molecules that mediate heredity and therefore natural selection. With the development of methods to analyze genes and DNA, genetics has become the dominant science underlying evolutionary biology and the technique of choice for addressing many evolutionary questions. Why? Because while genetic techniques have their limitations, on balance they are more objective than fossil analysis, with less chance of contamination by preconception, expectation—or wishful thinking.

Molecular techniques can be used to measure genetic variation among populations. A population's genetic profile undergoes a slow change over time, due both to random mutations—a phenomenon called genetic drift—and to natural selection. When subgroups of an initially homogeneous population migrate apart, their genetic profiles tend to change differently, to drift apart. The genetic difference, or *genetic distance*, between two populations thus gives an indication of how recently the two were one. Complex computer models use genetic distances to construct family trees that show how closely different populations are related.



Hominoid family tree Adapted from R.S. Corruccini and R.L. Ciochon (Eds.), (1994), INTEGRATIVE PATHS TO THE PAST, Prentice-Hall, Inc.

One of the most famous results using molecular techniques was the unraveling of the relationships between the great apes: orangutans, gorillas, common and pygmy chimpanzees, and humans. Before genes were used to construct family trees, anatomical studies suggested that chimpanzees and gorillas were very closely related, and it wasn't clear where humans fit in. However, much to everyone's surprise, molecular data has unequivocally shown that, in the great apes' family tree, the orangutan branch split off first, then the gorilla branch, and only much later did the chimpanzee branch split off from the line that has led to humans. Scientists are now studying genetic distances between more closely related species like the West African and East African common chimpanzees.

Like any tool, genetic analysis has its own potential for mishap. This young branch of evolutionary biology has had its share of controversies and embarrassments—due not to the genetic data itself, but to flaws in the complex computer programs used to analyze the data and generate family trees. Scientists are now more cautious about double checking computer-generated results before publishing them.

FUTURE DEVELOPMENTS

Today, evolutionary biology is even more of a composite discipline than ever, strengthened by the many different intellectual strands within it. While it continues to draw heavily upon the subfields like comparative anatomy and paleoanthropology that contributed so much to its early growth, evolutionary biology has been energized by a host of new arrivals: molecular biology, computer modeling, complexity theory. Like the subjects it studies, the field keeps evolving.

Although Darwin's theory of natural selection has been a powerful tool in addressing *why* questions, it is silent when it comes to the intriguing *how* questions: How does evolutionary change actually take place at the molecular level? How does a mutation in a strand of DNA change the number of vertebrae of a hominid, perhaps allowing it to walk upright more easily?

Until recently, many of the most interesting questions were too difficult to be studied. But an avalanche of discoveries in genetics has made molecular evolutionary biology one of the hottest and most promising areas of science today (a little unabashed advocacy for my own field of interest!)—one that *does* address those *how* questions. In the foreseeable future, we should be able to understand how changes in DNA sequences relate to changes in anatomy, and perhaps even how ecological change drives the whole process.

As Theodosius Dobzhansky, one of this century's most influential scientists, said, "Nothing in biology makes sense except in light of evolution." ■

***Scott Rifkin**, a senior majoring in biological anthropology at Harvard University, is interested in development and evolution, history of science, and aikido (among other things). He spent last summer simulating RNA evolution and studying complexity theory at the Santa Fe Institute.*

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Pondering the Legacy of Watergate

by Deborah Milner

Always intrigued by politics, this author wrote a history research paper about Watergate last year after hearing her mother talk about watching the Senate Watergate hearings. Here she explains what Watergate means to her and why, she believes, it continues to affect the American public today.

The more I think about the Watergate break-in, the more it seems like an episode of "I Love Lucy." I can see Lucy and Ethel, in outrageous disguise, attempting to sabotage the dressing room of one of Ricky's rival performers. (Or are they dressed up like men with walkie-talkies, trying to bug the U.S. President's political challengers?)

I have always been fascinated by the motives of the Nixon campaign staff who designed this plan to burglarize the Democratic National Committee headquarters. The Committee to Re-elect the President (ironically, abbreviated CREEP) had a very simple task compared with that of most political campaigns: to re-elect a popular president whose opponent appealed to few voters. There was no need for dirty tricks or paranoid spying. Why, then, this "Lucy"-like weirdness?

A Plot Unravels

On June 17, 1972, five men with CIA and Cuban connections broke into the main offices of the Democratic National Committee located in the Watergate complex. Their main objective was to plant a wiretap in the office of the DNC chairman, but a passing security guard caught the intruders. The cover-up began with payment of hush money to them from a secret White House slush fund. Illegal activity escalated with attempts to use the CIA to hinder the FBI investigation of Watergate, even though the CIA is not allowed to operate domestically. Despite the growing scandal surrounding these events, President Nixon easily won re-election in November 1972.

Senate Watergate hearings began in May 1973. Perhaps the most revealing witness was John Dean, former special counsel to the President, whose testimony went beyond the Watergate incident itself to expose many of the Nixon Administration's illegal activities, including wiretapping, burglary, money-laundering, and obstruction of federal agencies. Dean also disclosed that President Nixon had learned of the Watergate cover-up before the date the President had publicly named. Another White House staffer divulged the existence of the now-infamous tapes on which the President had recorded all the meetings in his office.

President Nixon issued a statement declaring that he had neither known of the funds supplied to those jailed for their Watergate participation nor tried to use the CIA against the FBI. However, the White House tapes, subpoenaed by the Special Prosecutor and turned over after a contentious delay, revealed these and other claims to be lies. The discovery of an eighteen-minute gap in one tape and a nineteen-minute gap in another—believed to indicate more cover-up attempts—further damaged Nixon's credibility.

On March 1, 1974, a Federal grand jury issued criminal indictments against former Attorney General John Mitchell, prominent members of the White House staff, and other members of CREEP. President Nixon was named an unindicted co-conspirator.

Then the House Judiciary Committee, charging the President with misconduct in office, approved three articles of impeachment: condoning of the activities of the White House staff in the Watergate cover-up, abuse of power and violation of the constitutional rights of U.S. citizens, and defiance of subpoenas. The articles were sent forward to the full House of Representatives, which was expected to vote to impeach the President.

After a long struggle with the Supreme Court, Republican leaders, and his own family, Nixon resigned on August 9, 1974, before he could be impeached.

Loss of Political Innocence

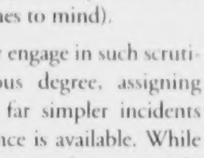
Although people often disagree about the degree of Nixon's involvement in the Watergate affair, they are likely to agree that the scandal has had dramatic and lasting effects on our country. Watergate defiled the presidency itself. Before this incident, a U.S. president was seen as somehow above the indignities of investigation. Even when corruption was suspected in the administrations of Nixon's predecessors, people in a position to investigate such matters had looked the other way. But Nixon went too far: never before had a president been caught lying so flagrantly to the nation.

As a result, Americans no longer completely trust any president or, by extension, any politician. Like Ricky, who was always suspicious of the schemes of Lucy and Ethel, the press and the nation now readily suspect wrongdoing by all our elected officials. But unlike Ricky, we fear the possibility not just of comical plots but of criminal and corrupt behavior—even by the president.

Yet, the aggressive investigation of our politicians has not necessarily led to justice. And, given the privileges of office, it is difficult to know whether such scrutiny has even led to greater legality or even accountability in the conduct of our public officials since Watergate. Too often, little resolution comes of any investigation (the lengthy and expensive Iran-*Contras* probe comes to mind).

In fact, we now engage in such scrutiny to a ridiculous degree, assigning "-gate" names to far simpler incidents even before evidence is available. While uncovering actual wrongdoing certainly benefits the country, overzealously focusing on trivial matters like the cost of a presidential haircut distracts our leaders from their elected purpose.

Certainly, no one wants to see the president or any elected official permitted to abuse the power of office. Yet, as a nation, we haven't fully resolved the legacy of Watergate: we haven't learned how to discriminate between serious abuses of the public trust and minor incidents unworthy of the nation's sustained attention. ■



Now a 12th grader, ***Deborah "Carly" Milner*** *plays the flute in the band at Dulles High School in Sugar Land, Texas. She plans to pursue a career in politics or economics.*

Making the Most of a Museum Internship

Volunteering at a local museum is one way to provide service to your community while enlarging your sphere of knowledge. Although internship duties may be clerical, working in a treasure-laden environment and exploring behind-the-scenes caches offer their own rewards.

Entering the Green Spaces

by Amanda Bell

On childhood visits to the Metropolitan Museum of Art in New York City, I was intrigued by the large, unlabeled green spaces on the visitors' floor plan. I guessed that they represented offices of some kind, but I also couldn't help believing that some of them must indicate storerooms filled with fantastic, unseen works of art, or labs lined with intent conservators holding tiny brushes and wearing green eyeshades. I never guessed that years later I would be working in one of those spaces as an apprentice in the Islamic Art Department.

As an apprentice I filed and photocopied catalogue cards, photographs, old exhibit labels, and other items that accumulate in curatorial offices. I also compiled catalogues of bygone exhibitions in the Hagop Kevorkian Gallery. These jobs were routine, but making the catalogues was fun, and reading the contents of the files could be entertaining. I learned about Islamic artifacts such as a brilliant Isfahan carpet undergoing restoration and white Nishapur ware decorated with calligraphic inscriptions from the *Hadith* (the sayings of Muhammad, e.g., "Knowledge is the glory of youth").

My supervisor, Trish, was very kind and often sent me on errands to offices, studios, and departments—more of those fabulous green spaces. Our technician, Katie, took me with her to exciting and inaccessible parts of the museum. For example, I saw the vault where jewelry and other precious objects not on display are stored, one of the Islamic storerooms, and the new textile preservation center. (Alas, the conservators were not wearing green eyeshades.)

Metropolitan Museum apprenticeships are available in most of the curatorial and conservation departments, the libraries, and miscellaneous offices. These positions are open to high school juniors and seniors who can work at the Met after school in the fall or spring or from nine to five during the summer. Students living outside the city may apply, too, but should consider travel time. My commute took almost two hours, so I had to go to bed every night at nine to be alert for work the next day.

To apply for a museum job, you first submit a written application. I typed my application, kept my answers succinct and creative, and added small line drawings in the margins. It's important to consider in advance which departments you want to work in. If you simply want to work somewhere at the museum, request several departments you'd like. If you *only* want to work in Musical Instruments, say so. To receive an application, call the museum at (212) 879-5500, and ask for the Education Department. The application deadline for the summer program is in March. ■

Now a freshman at Yale University, ***Amanda Bell*** *enjoys writing, doing community service, and painting. She usually wears a floppy grey hat, but not in summer, just in case you knew her at CTY*

Holding History in My Hands

by Shelli Calland

During the summer after 10th grade, I worked as a volunteer at the Cleveland Museum of Natural History and at the Cleveland Children's Museum. My parents value community service highly, and my high school also encourages volunteerism and records service hours on our transcripts.

I found these positions just by calling both museums in the spring and explaining that I was a student willing to work as a volunteer summer intern. I learned that these—and many other—museums are eager to accept such an offer and that a substantial amount of significant work in these institutions is done by volunteers. After short, pleasant interviews, I chose assignments in the Archaeology Department of the Natural History Museum and the Public Relations Department of the Children's Museum.

During the first few weeks of the summer, my job at the Natural History Museum involved numbering and cataloguing items discovered at a large construction site in downtown Cleveland. Most of these items were old jugs and bottles, some of which were intact. To catalogue them properly, I had to learn about the types of containers, characteristics of glazes used on ceramics, and ways to describe the specific look and feel of glass. Several of these artifacts were later displayed in a special exhibit celebrating Cleveland's bicentennial.

For several mornings, I helped reorganize the Archaeology Department's archives, sorting and storing maps, field notes, photographs, and other records. During the last few weeks of the summer, I carefully and methodically cleaned ancient bone fragments, flint chips, pottery shards, shell bits, charcoal, and other objects unearthed at an excavation near an Indian mound in southern Ohio.

At the end of each morning, I explored the private sections of the Natural History Museum and discovered many fascinating things that are not on public display. After lunch I walked through the beautiful grounds of the Cleveland Museum of Art to the Children's Museum. There, I wrote press releases and articles for their newsletter and designed and edited brochures describing temporary and permanent exhibits.

At the end of that summer, I knew my work had been not only rewarding but also truly appreciated. Volunteering as a museum intern clearly can be a win-win situation. ■

Shelli Calland *is a 12th grader at Shaker Heights (OH) High School. She enjoys solving math and logic puzzles, reading philosophy, arguing, and watching the marmot (don't call him a ground hog!) that lives in her back yard.*

The Evolution of the Contemporary Museum

"How far we have traveled during the span of only a single lifetime in our understanding of what a museum can be!"

—Chaim Potok, on the opening of the U.S. Holocaust Memorial Museum

Not long ago, the primary goal of most museums was to serve as repositories—of artifacts, aesthetic objects, exotica. Museums housed collections of items usually identified one by one in display panels on walls. Background for a particular collection might also be provided: the facts of an artist's life, for example, or details of a relevant historical event. For the most part, though, museums pursued limited educational goals and did not actively reach out to visitors.

But in the last few decades, museums have evolved. Many have adopted ambitious educational programs, and some have taken the possibilities of education to the limit.

In San Francisco in 1968, Dr. Frank Oppenheimer founded the Exploratorium, one of the world's first participatory learning centers. This innovative museum was designed to facilitate hands-on learning about nature, science, and technology. Today, visitors to the Exploratorium may choose from among 650 interactive sites to set up and conduct their own scientific experiments.

Interactive museum sites differ greatly, depending on each museum's intent and design. But their general purpose is to provide participatory opportunities that are shaped by the visitors' own curiosity and by their intellectual and even emotional responses. With stunning architectural designs and multimedia communication strategies, some of today's museums offer visitors learning experiences that are in a class by themselves.

HISTORY AND THE MUSEUM

The U.S. Holocaust Memorial Museum

by Lesley Mackay

Can a museum help us to explore the worst examples of human behavior? Can a museum challenge us to experience times in human history that many of us might prefer to forget? Finally, can such a museum educate its visitors in a soft-spoken, rational way that elicits compassion and resolve? Yes, said the designers of the U.S. Holocaust Memorial Museum.

Founded in April 1993, the Holocaust Museum in Washington, D.C., engages both the intellect and the emotions. While providing a tremendous amount of information, this institution also deliberately sends visitors on a painful historical journey. Then it encourages them to emerge from that journey more knowledgeable, courageous, and humane.

The Holocaust Museum: Information . . .

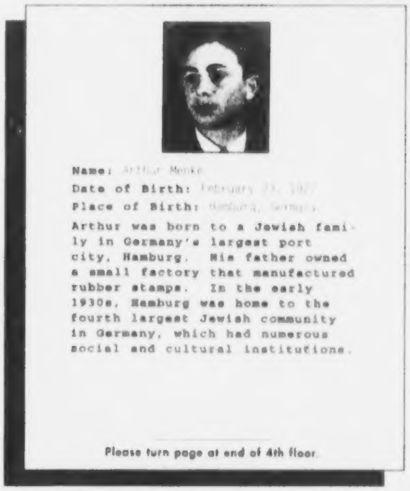
The Holocaust refers to the systematic, state-sponsored extermination by the Nazis and their collaborators of approximately eleven million victims, roughly six million of whom were Jews. The museum thoroughly investigates this terrible event, perpetrated by thousands and ignored by millions.

It is impossible to learn about the Holocaust without reflecting on its significance. The museum itself thinks aloud as we pass through it, offering insights and meditations integrated into its exhibits. It doesn't think *for* us, though. Visitors are given ample time and space to forge their own responses.

Marcia Sabol, first coordinator of teacher training at the museum, offers her own sense of the Holocaust's significance: "This event has often been regarded as a Jewish tragedy because of the number of Jews who died. It is also a human tragedy that a group would single out Jews, Gypsies, the handicapped, homosexuals, Poles, and Slavs on the grounds that they were unworthy of life. This isn't simply intolerance; it's mass murder."

While focusing on the systematic, murderous agenda of the Holocaust and on its terrible consequences, the museum also raises and explores related topics of great importance. Visitors can learn through a prism of issues and events. Anti-Semitism, book burning, World War II, media bias, immigration policies, and the 1936 Olympic Games are but a handful of the many topics raised and carefully explored at the museum.

. . . and Identification



Name: Arthur Menke
Date of Birth: February 23, 1927
Place of Birth: Hamburg, Germany

Arthur was born to a Jewish family in Germany's largest port city, Hamburg. His father owned a small factory that manufactured rubber stamps. In the early 1930s, Hamburg was home to the fourth largest Jewish community in Germany, which had numerous social and cultural institutions.

Please turn page at end of 4th floor.

Balanced against facts, figures, documentation, and analysis are powerful emotional reminders that Holocaust victims were real people. Here are some of the ways in which the museum emphasizes their humanity:

- *Each visitor receives, upon entry, a bound beige booklet that looks a little like a passport.*

On the first page is the name and photograph of a real person who lived during the Holocaust, along with information about his or her family. On subsequent pages is information to be read as the visitor reaches the end of each of the museum's three floors; these individual short readings reveal what occurred in the life of the visitor's "companion" during the events covered on the respective level. Thus, the visitor's journey through the museum parallels the individual's experience of the Holocaust.

■ *Visitors walk through the Tower of Faces, a three-story glass tower.*

The tower exhibits 1,000 prewar photographs of Jewish inhabitants from the Lithuanian town of Eiszyszki. The myriad photographs on the cylindrical transparent walls are varied, often beautiful, seeming to capture spiritual and artistic qualities in their subjects.

However, we soon learn that, except for 29 survivors, this town's entire Jewish population of 3,500 was slaughtered in two days. The visitor passes through the tower once before learning about the campaigns of extermination that brought about this mass homicide—then passes through the tower again at another level after understanding what happened to the people who live in black-and-white film on the wall.

■ *At the end of the museum tour, visitors can sit in an amphitheater and watch a film in which Holocaust survivors talk about their pasts.*

The survivors, now elderly people, recall the despair and hope of this period, the relationships that sustained them, and the terrible losses they suffered. The visitor's last experience of the exhibit, then, is of the quiet words of speakers who could be his or her grandparents.

Answers and More Questions

Rather than providing conclusive answers, the Holocaust Museum leads visitors from question to question. Who was responsible for the Holocaust? The museum teaches about the evil initiatives of Nazi leaders. Who else? The museum documents collaboration with and enthusiastic support for those leaders throughout much of Europe. Who else? The museum investigates the roles of the hundreds of thousands of people who carried out the directives of Nazi leaders. Who else? The museum returns again and again to the critical role of bystanders—those millions of Europeans who neither supported nor resisted the Holocaust. Who else? The museum reveals the silence and passivity of governments around the world who did not act on what they knew about the Holocaust—who even declined to open their borders to refugees fleeing for their lives.

Examples of Complicity at Home

In thinking about complicity, visitors to this American museum are asked to confront the role of the United States. U.S. soldiers played an important part in freeing inmates from concentration camps at the end of World War II. But prior to liberation, the U.S. consistently refused to become involved in rescue activities and severely restricted access to its shores by refugees from Nazi-occupied territories.

One of the most affecting exhibits explains the fate of a ship and its passengers. In 1939, the German steamer *S.S. St. Louis* carried more than 900 Jewish refugees to Havana, Cuba. Upon arrival, the refugees were refused entry into Cuba; they were then also denied visas to land on the U.S. shore. The ship returned to Europe, where many of its passengers eventually were murdered.

Thinking about Victims and Perpetrators

By posing question after difficult question, the museum constantly restates the problem of moral responsibility for the Holocaust. Although naming its criminal leaders may be easy, defining responsibility among the general population is more difficult. And so, visitors are asked to identify not only with the victims but also with bystanders who silently condoned this calculated, gross inhumanity.

"The museum encourages each visitor to ask, 'What would I have done?'" says Marcia Sabol. "It pushes us to think about our own response to evil."

What a Museum Can Be

How does the Holocaust Museum accomplish so much? To answer this question, one has to refer to its impressive and complex architectural design. The multistory building is stark, somber, and cool. Throughout, it integrates features we might associate with oppression and captivity: large towers designed to resemble watchtowers, red brick walls, buttresses and railings of dark gray steel.

Hundreds of authentic artifacts intensify the realism of the atmosphere: a milk can in which residents of the Warsaw Ghetto hid documents that recounted their struggles, a huge pile of victims' shoes, blue-and-white-striped uniforms of concentration camp inmates. By creating a desolate physical space and presenting affecting historical objects, the museum provides a flickering emotional sense of the reality of the Holocaust experience.

According to principal designer Jeshajahu Weinberg, the Holocaust Museum has a *narrative* structure—it is organized around a story line. The strength of its design elements allows visitors to experience the Holocaust's unique and terrible power. The story draws each visitor in, partly by arousing compassion and many uncomfortable emotions, but primarily by presenting information and encouraging understanding.

The millions of Holocaust victims stand at the center of this understanding. The departing visitor is prominent, too, challenged never to comply with a repetition of this terrible event. ■

Inmate barracks at the Auschwitz-Birkenau concentration camp in Poland. Former CTYer ***Rena Bunder*** *took this photograph while on the 1996 March of the Living, a two-week trip to Poland and Israel organized every two years for 7,000 teenagers from 48 countries.*

Calendar for College Planning and Preparation

Part I: Grades 7, 8, 9

by Linda E. Brody, Ed.D.

Academic preparation is the first and most fundamental aspect of getting ready for college. Begin planning your academic schedule in middle school and continue throughout high school, so that you will acquire the background and credentials required by the college of your choice.

Also set aside time to contemplate your own needs and investigate college options. If you wait too long, you may find yourself as a high school senior confused about what you want in a college, with no idea of where to apply, and without the course preparation you'll need to succeed.

We offer this calendar as a guide to help you plan ahead.

Part II, for grades 10-12, will appear in the January/February 1997 issue of Imagine.

Grades 7 & 8

- If you're eligible, participate in a regional talent search. You will gain insight into your abilities and educational needs, along with access to a network of educational opportunities and information.
- Take challenging courses. Investigate getting high school credit for advanced courses taken in middle school.
- Study a second language.
- Develop your writing skills.
- Develop your computer skills.
- Consider supplemental educational opportunities such as academic summer programs, distance learning options, and part-time high school or college courses.
- If you are having academic difficulties, seek tutorial assistance. If difficulties persist, consider being evaluated for possible learning disabilities. Postponing getting help could leave you without the knowledge base to succeed in high school.
- Join clubs and activities that allow you to experiment with new interests.
- Read books, periodicals, and newspapers to improve your verbal abilities and expand your knowledge.
- Investigate career fields through reading, volunteering, taking career exploration tests, and talking to adults about their work.
- Evaluate high school options in your community. For example, is a magnet school or International Baccalaureate program available?
- In cooperation with your middle school guidance counselor, develop a tentative four-year program of high school courses.
- Use your summer to expand your learning: take a course, travel, pursue volunteer work in an area of interest.

References

Berger, S.L. (1989). *College planning for gifted students.* Reston, VA: Council for Exceptional Children.

College bound: A comprehensive guide to optimal preparation & decision making. (1994). Baltimore: IAAY Publications & Resources.

Grade 9

- Review your four-year plan with your high school guidance counselor. Include rigorous courses in math, science, English, social studies, and at least one second language, as well as electives in other areas of interest. Plan to take Advanced Placement (AP) courses offered by your school before you graduate, or to enroll in an International Baccalaureate program if it's available.
- Evaluate whether summer programs, part-time college courses, or other supplementary options should be part of your four-year plan to provide you with sufficient preparation for college.
- Evaluate your current courses and make changes if necessary. Course work should be challenging and rigorous, but not so difficult that your grades are poor or that you feel under-confident or confused.
- Seek help in developing any skills you lack to succeed in your courses—especially writing, computer, and study skills.
- Participate in extracurricular activities. Begin to identify those that really interest you and in which you might aspire to hold a leadership position.
- Investigate the resources of your school guidance office and/or career center for college and career information.
- Take any SAT II Achievement tests and AP exams relevant to your courses this year. If you will continue course work in certain subjects such as English, postpone SAT II tests to maximize your score later.
- Read books, periodicals, and newspapers as you continue to expand your base of knowledge and understanding.
- Begin to visit colleges in your area and tour others while on vacation. Even if these particular schools don't interest you, early visits will help you clarify what you want in a college or university.
- At the end of the school year, reevaluate your four-year plan. Consider whether you need to arrange any courses for fall outside school, e.g., at a local college or through a distance learning program.
- Use your summer to expand your learning: take a course, travel, pursue volunteer work in an area of interest. ■

If you missed our September/October issue on "Planning Ahead for College," you may order a copy by calling (800) 548-1784.

SCIENCE OLYMPIADS: GOING FOR THE GOLD

At IPhO award ceremony: (from left) Norwegian guide, Lujan, Turner, Hirata, Pahk, Houck.

by Eileen Ptak

This summer, millions of viewers worldwide watched the 100th Olympic Games televised from Atlanta. Who can forget the thrill of watching Kerri Strug vault for the gold with an injured ankle, or the excitement of seeing Michael Johnson break his own 200-meter world record?

The Olympic Games present a rare and wonderful opportunity for nations to join together to honor the excellence of the world's finest athletes. Ideally, the communal setting and shared experiences also enable countries and individuals to learn to communicate better.

These same goals come into play in the International Science Olympiads—annual competitions in chemistry, computer science, mathematics, and physics. Some of these events were initiated by the United Nations Educational, Scientific, and Cultural Organization (UNESCO) to promote collaboration and communication through scientific education. All of them honor academic excellence among high school students.

Beyond providing a venue for intellectual challenge, the International Science Olympiads enable students to interact with their peers from many other cultures. In fact, the value of such experiences may equal the significance of the competitions themselves.

At this summer's International Physics Olympiad in Oslo, Norway, Christopher Hirata won a gold medal and placed fifth among 260 participants. But when asked about his experiences, Chris talked most about the American team's adventures with the Australians who roomed across the hall: taking a boat trip on a fjord, getting stuck in the mud in an Oslo forest, and trading predictions about who would be awarded gold, silver, or bronze. Wait a minute, wasn't there a test? "It was sort of difficult," he conceded.

XXVII International Physics Olympiad (IPhO)

June 30-August 1, Oslo, Norway

Thirteen-year-old Chris Hirata (IL), who received the Youngest Medalist award, won a gold medal along with team members Joon Pahk (VA) and Ari Turner (NM). Andrew Houck (NJ) and Paul Lujan (CA) garnered bronze medals. China, Romania, and the U.S. placed first through third, respectively.

Candace Cheng and David Maybury at work on lab experiments during the training camp held before the IChO.

37th International Mathematics Olympiad (IMO)

July 7-21, Bombay, India

U.S. team members Carl Bosley (KS), Christopher Chang (CA), Michael Korn (MN), and Alexander Saltman (TX) received gold medals. Nathan Curtis (VA) and Carl Miller (MD) were awarded silver. In overall standing, the U.S. placed second, only two points behind top-ranking Romania.

XXVIII International Chemistry Olympiad (IChO)

July 14-23, Moscow, Russia

Henry Fu (OH) won a gold medal and placed eighth individually. Alex McVay (MA) and G. Michael Sawka, Jr. (CA) earned silver medals, and Jason Chen (CA) was awarded a bronze. The top-ranking teams were Russia, Iran, and the People's Republic of China.

VIII International Olympiad in Informatics (IOI)

July 25-August 1, Veszprém, Hungary

Dan Adkins (LA) won a silver; Matt Craighead (MN) and Keldon Jones (OK) earned bronze medals. Joseph Turian (NY) also competed with the U.S. Team. The IOI's top five teams were China, Russia, Slovakia, Poland, and Romania. The U.S. ranked 22nd overall.

How to Compete

IChO: Ask your teacher or guidance counselor how to apply for the qualifying exam. Twenty finalists are invited to a two-week training camp at the U.S. Air Force Academy in Colorado, where four are chosen to make up the U.S. team.

Education Division, American Chemical Society, 1155 16th Street, NW, Washington, DC 20036; (202) 872-6169; fax (202) 833-7732.

IMO: High scorers on the American High School Math Exam (AHSME) and the American Invitational Math Exam (AIME) are invited to take the USA Mathematical Olympiad (USAMO) exam. The six highest scorers form the U.S. team.

Dr Walter Mientka, Executive Director, American Mathematics Competitions, 1740 Vine Street, University of Nebraska, Lincoln, NE 68588; (402) 472-2257; fax (402) 472-6087; walter@amc.unl.edu

IOI: Students representing the U.S. at the IOI must first excel in three rounds of problem-solving in the USA Computing Olympiad (USACO).

Dr. Donald T. Piele, Director, USACO, University of Wisconsin-Parkside, Kenosha, WI 53141; (414) 595-2231; http://usaco.uwp.edu

IPhO: Each fall, physics teachers nominate students to compete for places on the U.S. team. Talk to your teacher if you are interested.

American Association of Physics Teachers, One Physics Ellipse, College Park, MD 20740-3845; (301) 209-3344, fax (301) 209-0845

EXPLORING CAREER OPTIONS: COMPUTER SOFTWARE RESEARCH AND DESIGN

by Carol Blackburn

Interview with David Anderson, John Barrus, and Richard Waters

In this interview, we talk about innovative computer software design with three computer scientists. If what they have to say sometimes sounds more like science fiction than science, it's because they're doing cutting-edge work. We hope you'll enjoy this glimpse of one face of software's future.

A VR Ride through Diamond Park

"Are we going through a wall right now?"

"Yes, we are, because I haven't implemented this obelisk yet."

What on earth are these people talking about? Actually, they're not talking about anything *on* earth. The wall in question exists in a virtual reality (VR) called Diamond Park, created by a team of scientists and artists at Mitsubishi Electric Research Laboratory (MERL) in Cambridge, Massachusetts. John Barrus, leader of the team that created Diamond Park, is giving me a tour of his one-mile-square virtual world.

In the real world, he and I are riding computer-controlled bicycles and using headsets. Our movements are translated into the movements of our VR facsimiles: as I pedal faster, my facsimile moves faster. On a video screen in front of me, vistas of Diamond Park unfold, seen from my facsimile's vantage point: hills, lakes, a café, a museum, even an old castle ruin.

"Darn, I just hit another hole." John's VR biker has stopped dead, even though in the real world John continues to pedal.

"Are we waiting for more information to load, or did you plant gopher holes around the Park to increase the verisimilitude?"

John laughs. "We have tried to make the experience seem realistic in many ways, but not by including gopher holes. No, I haven't fully debugged the terrain-following program yet."

Although John and I are in the same room at MERL, we could as easily be on opposite sides of the country, biking together and conversing in VR. Diamond Park is a *multi-user interactive environment*, meaning that several people can be in it together, interacting not only with the virtual environment but with each other—talking, even working together on a structure within VR. Diamond Park is a prototype designed to showcase MERL's sophisticated new program for multi-user VR.

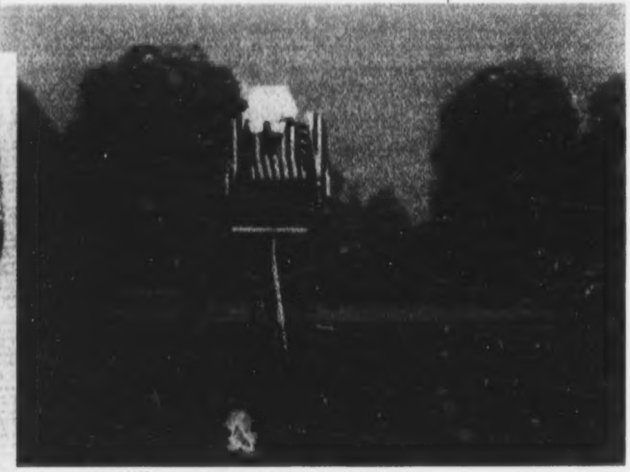


Image courtesy of MERL

And the obelisks? As John explains, "Since the Park is one mile square, it takes a while to pedal around it. So we scattered transporter sites—the obelisks—around the Park." We enter the nearest one, an airy pavilion with many exits, each of which reveals a different view: the aquarium, the summit of a hill, the castle ruin. We bike across the pavilion and, without any audio-visual discontinuity, exit directly into another part of the Park.

This seamless transition is made possible by *locales*—VRs within a VR. "There's a natural desire to want to make large and complex virtual environments. Locales are an efficient method of breaking up a virtual world into compact chunks more manageable for both the programmer and the computer." Unlike hypertext links, which jump from site to site, locales allow continuous movement from one site to another, even from one VR to another. "They allow us to set up very large virtual environments that are connected in interesting ways."

We bike up the entry ramp to the Planetarium locale, go through the doorway, and suddenly are on a balcony overlooking the Milky Way. "One of the many fun things about VR is that you're not confined to Euclidean space; here, space can overlap," John explains. "We've exploited that in creating our locales. From the outside, the Planetarium looks tiny, but it 'houses' the universe. It's an illusion—you enter a small space and find a vast one inside—yet, surprisingly, it's not confusing."

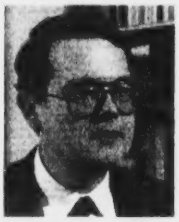
"One of the great things about our program is that you can create additional locales and simply add them in later. So the complexity of any virtual environment can continue to grow, well beyond the scope of the original design."

John's eyes sparkle as he shares his vision of the future of multi-user VR. "It would be great if people could design their own VRs and spend time in them with friends or family, enjoying each other's creations. We hope that some day soon there'll be a vast, interconnected web of virtual environments—a kind of World Wide Web in 3D instead of 2D." Imagine surfing that!

We just had a glimpse of Diamond Park. Could you start by telling us more about your work?

When you say the words "virtual reality" (VR), most people today think of violent combat games. We believe this technology can surely be applied more creatively. More and more, people would like to find ways to pursue activities from their homes—from distance learning to spending time with friends who live elsewhere. Virtual environments offer extraordinary possibilities for individuals, no matter where they are in the real world, to come together for class, work, or play. At MERL, we're doing our part to bring such multi-user interactive virtual environments to the world.

John: We were inspired in part by the popularity of MUDs (multi-user dungeons), cyberspace playgrounds in which users communicate by writing to one another. We thought, if playing in a MUD, where you "converse" by typing, is fun, imagine how much more fun multi-user interactions could be in a VR environment.



Richard: Most VR products to date have tended to focus on maximizing the perceptual realism of an individual's experience, but we've focused on the opportunities VR offers for people to interact in virtual environments—what one expert in the field has called "social VR." At MERL, we've been doing basic research in the design of software for multi user VR, laying the groundwork for others to design their own VRs.

This sounds like a huge project. How did it evolve, and how long have you been working on it?

Richard: In 1992, we made a few preliminary stabs at designing virtual environments. From our early efforts, it was clear we would never get anywhere if we were building each one from scratch; we needed some sort of standard platform on which to build. So our emphasis switched to building one, which we've called SPLINE (Scalable Platform for Large Interactive Networked Environments). David and I led the SPLINE development, while John simultaneously led the effort by artists as well as scientists and engineers to create a prototype VR, Diamond Park. The programming for SPLINE took about five man-years of effort, for Diamond Park about four.

What do you mean by a "standard platform"?

David: A platform is software that "sits" between a computer's operating system and an application program. It's invisible to the *user* but crucial to a *programmer* because it dramatically reduces the amount of code that needs to be written; all the platform's built-in features are available for use by a programmer and do not have to be written into the application software. In SPLINE's case, those built-in features include support for multiple users, 3D graphics and sound, and many, more advanced features.

John: One really exciting feature we built into SPLINE is "run-time modifiability": users can make permanent modifications to a virtual environment while it's running. In Diamond Park, for example, users can redo the landscaping in the Desert House, which is a sort of gardening lab. With the permission of the "owner," users can also add new locales, just as one now adds links to a Web page. This feature will allow the content of a virtual environment to grow in proportion to the talent of the user community, not just of the system designers.

How did you get involved in VR research?

Richard: Five years ago, Mitsubishi Electric decided they wanted to have a good, basic research lab in software, and MERL was formed. We receive no direction as to what to work on; the fact that we're developing this software is our own idea.

John: Our parent company was initially a little apprehensive about our work on Diamond Park. One person said, "It looks like a video game … and we don't make video games." But interest within the company has grown rapidly. People from many divisions have seen what we're doing and have realized, "I could use that technology in my own department"—in worker training, automobile design, conferencing, or whatever.

Where are you headed next with this work?

John: We're just finishing debugging Diamond Park now. We'll continue to add to it, to enrich it. But SPLINE is going in a different direction: Dick and David are writing a PC version so users can run it on computers that are less expensive than the high-end (that is, powerful and expensive) ones we're now using.

You can support this on a PC?

David: Not the graphics, but you can support everything else on a PC today. The largest computational cost is making the pictures. Our expectation is that next year's 3D graphics cards for PCs will allow them to support images like those we now generate on high-end computers.

John: It was clear to us that most people would not be able to use SPLINE unless it could run on a PC. When we began creating SPLINE, PC graphics and computations were a little too slow. We started working in high-end machines, knowing that in very few years you'd be able to run SPLINE on a PC. And that's what's happened.

That's impressive. I wouldn't have imagined you could bring this to PCs so soon.

Richard: To give credit where credit's due, it's not simply that we have brought it to PCs; PCs have also come to us. It's absolutely astonishing how hardware research has leapt forward. Our ability to move this program from a $100,000 computer to a $10,000 one *could* be because we figured out how to make all the algorithms fit into one-tenth the space and run ten times faster, right? The truth is, we've maybe figured out how to make the algorithms fit in 2-3% less space, while the hardware guys are giving us machines ten times as powerful for the same price. We're improving our ability to write software at a rate of perhaps 5% a year—which is impressive for most fields, but is dwarfed by the 30% improvement per year that hardware engineers have been able to obtain.

Aside from playing in Diamond Park, what do you enjoy most about your work?

David: I've enjoyed this particular project because it's the first thing I've worked on in my career that my mother can understand.

Richard: That's an enjoyment we do sometimes lack, isn't it? Myself, I look at designing software exactly like creating a work of art, like painting a painting. You fuss over it, you change this, you change that. I take great satisfaction from a beautifully-written program, one that not only works but *looks* like it works. I think undergraduate programming courses do too little to teach students to appreciate a program as a piece of literature.

David: I think of a program more as a sort of living thing, as a thing that's inside the machine, and I'm interested in wringing all the performance possible out of the hardware to achieve some effect. I enjoy thinking about how to create the best experience for the user given the resources available.

That reminds me of Michelangelo, who viewed his work as liberating the sculpture imprisoned in a block of marble.

David: I've never been compared to Michelangelo before, but I'll take it as a compliment!

John: What I enjoy the most is ... you have these subroutines running around in the computer, doing different things. To make them do what you want is nice, but even more exciting to me is to have them connect to the real world—make a motor move, or make it harder for you to pedal as you go uphill in Diamond Park. Just typing at the keyboard doesn't excite me much, but having those subroutines do or mean something in the real world, that's where I get really excited.

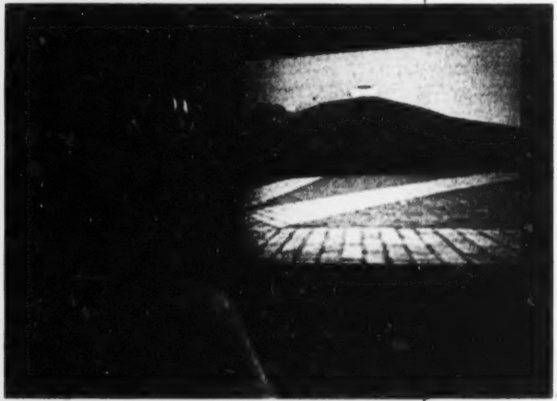


Image courtesy of MERL

I also love the collaborative aspect of being part of a big design project. Brainstorming—and then trying to figure out how to implement the ideas we come up with—is very energizing. What we've created together is much greater than what any of us could have done alone, in terms of both the ideas and the actual programming, when all the pieces fall into place.

David: In a way, that's true for the field as a whole. We don't build all the component parts we need; we use a lot of software written by others. In writing SPLINE for PCs, we're using Java and VRML (Virtual Reality Mark-up Language) and other exciting technologies that didn't exist when we began a few years ago. As new software comes along, new industry standards are set.

John: One computer guru has compared this field to building a city: a vast enterprise to which many contribute, and all benefit from others' innovations. As in a city, infrastructure becomes outdated, obsolete; in the software metropolis, we're constantly engaged in an enormous amount of urban renewal—sometimes renovating, but often demolishing and rebuilding from the ground up. Both hardware and software continue to evolve at an extraordinary rate. In a way, it's almost like working with a living system.

One that is evolving incredibly quickly! Do you enjoy the field's fast pace and competitiveness?

John: No. (laughs)

Richard: It has its pluses and minuses; I'm not sure the pluses outweigh the minuses. It's tiringly frenetic. One nice thing about doing *basic* research is that you can get a head start. Very few people have the $100,000 computers for which we initially programmed SPLINE. We had the luxury of doing research whose results would not be economically viable for four or five years. But even with our four-year head start, the pack is now beginning to catch up like a herd of buffalo. If we'd had only a three-month head start, we might not have been able to complete SPLINE before others completed something like it.

How did each of you get into this field?

Richard: The first time I ever touched a computer, I was 20; that was in 1970. Back then, computers were still million-dollar, room-sized machines with punch cards.

I majored in physics in college, but in 1970, it was clear that only the top 5% of newly-minted physics Ph.D.s actually got to do what they wanted. And I didn't have quite enough hubris—even at 20—to assume I would be in the top 5% of Ph.D.s eight years down the road. So I decided to look a little more widely (probably the only pragmatic decision from that period of my life). I enjoyed computer science (CS), and it looked like a better bet, so I did a Ph.D. in CS at MIT.

David: I first touched a computer when I was a senior in high school—a little younger than Dick, but still quite old by today's standards. I loved math and was a math major in college, but I took so many CS courses that I ended up with a degree in CS as well. When I graduated, I decided I wasn't going to shake up the world if I went on in math, so I switched to what I enjoyed and got a Master's in CS at Carnegie Mellon.

John: I had some programming experience in high school. In college, I majored in mechanical engineering because I figured I could always get a job in that field.

DIAMOND ◊ PARK

Image courtesy of MERL

While completing a Ph.D. in mechanical engineering at MIT, I started working on computer-aided design. That's how I became heavily involved in computers and computer graphics. I've gradually moved almost entirely into CS-type stuff, although I like being involved with the CS/mechanical engineering interface of the work we do here.

Do you find it helpful to know a lot about another discipline—be it mechanical engineering or physics or math—in addition to CS?

John: For me, it's a big advantage because not many people know both. While we were creating Diamond Park, for example, my knowledge of mechanical engineering allowed me to work closely with the engineers who developed the exercise bicycle interface.

Richard: Having a foot in two camps is, I think, a good strategy for the future. In any technical field, you have to burrow pretty deep in a small number of spots. But if you know about more than one thing, if you adroitly pick two or three areas to know well, you can make yourself a more unusual commodity. The sound engineer who worked with us on Diamond Park has an undergraduate degree in music composition and a graduate degree in CS—a valuable combination of skills.

David: I regret that I didn't follow up on some of my other interests, that I focused so exclusively on hard sciences. If I had it to do over again, I would take classes in film and design and art—things I enjoyed but didn't pursue. Looking back, I had an amazingly narrow view of the kinds of jobs that exist. I never dreamed, for example, that artists could have the kind of fun they had working with us!

Do you have anything else to say to readers interested in software design as a career?

John: The market for good software designers is strong and likely to remain so for some time. It's a fast-paced business, but if you have the skill, creativity, energy, and drive, it can be a very fun way to make a living.

Richard: In general, my advice is to go with what you're interested in; don't try to be overly pragmatic. While my decision to go into CS was a pragmatic one, it was also one I made with genuine enthusiasm. I didn't have to bite the bullet to choose CS. In any technical field, you have to pay your dues; you have to learn a large body of knowledge that other practitioners know before you can get anywhere. And only genuine interest is going to get you through all that stuff.

I also think it's worth noting that, in CS you do not need a Ph.D. to do exciting work. CS hasn't been around that long. In contrast to the other sciences, in CS you can learn a large percentage of what there is to know about the field in a good undergraduate program.

David: This is a young field. Every day we do something no one has ever done before. That's a pretty exciting feeling. ■

Selected Resources

MERL's website:
http://www.merl.com/svr.html

Cringley, R.X. (1992). *Accidental empires*. New York: Addison-Wesley.

Peterson, I. (1995). *Fatal defect: Chasing killer computer bugs*. New York: Times Books.

- **PBS recently aired a series based on Cringley's book: *Triumph of the Nerds* is a fascinating, two-and-a-half-hour examination of the history of the software industry. Available from PBS Home Video; see http://www.pbs.org**

THE COACH'S CORNER

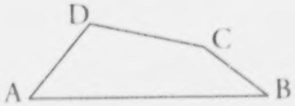
by Chengde Feng

Mr. Feng *teaches mathematics at the Oklahoma School of Science and Mathematics (OSSM) and has coached many students who have competed successfully in mathematics contests in China and the U.S. In this column, Mr. Feng offers* Imagine *readers questions designed to improve their problem-solving skills.*

1. Show that $18^{35} > 35!$

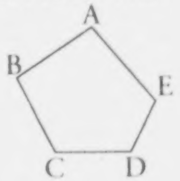
2. Given that $1 + 2 + 3 + \cdots + n = \overline{aaa}$ where $\overline{aaa}$ is a three-digit number with same digit a. If $1 \le a \le 9$, what is the value of n?

3. In quadrilateral ABCD, $\angle DAB$ and $\angle ABC$ are complementary, $AB = 7$, and $CD = 5$. Find $AC^2 + BD^2$.



4. Given that $f(x) = \sqrt{8x - x^2} - \sqrt{14x - x^2 - 48}$, find the maximum value of f(x).

5. In the figure, A,B,C,D, and E are the five vertices of a convex pentagon in the plane. Let λ be the ratio of the longest distance l to the shortest distance s between them. Prove that $\lambda \ge 2 \sin 54°$.



MATHEMATICAL PROBLEM SOLVING TECHNIQUES

by Alexander Saeed

Having radically accelerated his education, ***Alexander Saeed*** *(17) holds a B.A. in Biology/Psychology and an M.A. in Psychology from The Johns Hopkins University. He is now doing research in molecular biology under Nobel laureate Dr. Hamilton Smith.*

Solution to "The Chessboard," posed in our September/October issue

To solve the problem of protecting the world's largest chessboard from severe storm damage, we could use a trial-and-error approach. But let's try to reason our way through this puzzle.

While you are awaiting delivery of your rush order of 31 enormous Perma store boxes, you take a look at the structure of your giant chessboard. Because the upper left and lower right squares are still unfinished, 62 squares remain, alternating black and white in a staggered pattern. Each Perma-store box exactly covers two adjacent squares. So wherever you lay down a Perma-store box, no matter which way you turn it, you inevitably cover one black and one white square. Covering two black or two white squares at a time is impossible.

Given the alternating pattern of a chessboard, diagonals are composed either of all white or all black squares. With the missing upper left and lower right squares being on the same diagonal, they must be the same color—in this case, black. You realize that, after covering the board as much as possible by laying down 30 boxes, you will still have two white squares left over. Because the squares are the same color, you can't possibly cover them with the remaining box; they will remain vulnerable to the threatening storm.

Fortunately for you and the world's largest chessboard, the massive storm dissipates. (Your rush order was lost at the factory, so you cancel it without penalty.) Taking advantage of the now sunny weather, you put the finishing touches on the last two squares.

Then you hear reports of an impending earthquake ... just kidding!

FASCINATING CLASSICS

KIM

by Rudyard Kipling

Review by
Lesley Mackay & Ned Balbo

Lesley: Last time we met, we talked about Zora Neale Hurston's *Their Eyes Were Watching God*. Today, we are going to discuss British author Rudyard Kipling's turn-of-the century work, *Kim*. This book describes the adventures and evolving relationships of a homeless orphan of Irish descent growing up in British-ruled India.

Ned: Kipling and Hurston have very different writing styles. Hurston's prose is natural, often lyrical, easily combining the fluency of spoken language with a writer's precision. Kipling's narrative voice reflects a more formal approach. To contemporary readers, his sentences may seem more slowly paced and more densely packed with detail. But the thoroughness of his descriptions can be rewarding.

Lesley: I found this novel difficult to read. Now that I've finished it, though, I consider the effort worthwhile. The first half of Kipling's book requires the reader to grapple with lengthy accounts of the sensuous cornucopia that is India. At times, the narrative seems, more than anything, a catalogue of different settings and their unique blends of sights, sounds, and smells.

Ned: I can imagine why Kipling adopted this cataloguing strategy. In an age before film or television, with his country's empire stretching far around the globe, Kipling wrote for British readers intrigued by India. *Kim* can be read on one level as a travelogue brimming with the exotica of a prized colony few Britons would ever visit.

Lesley: While *Kim* is full of the details of bazaars and streets, cities and Himalayan foothills, and even the sensory stimuli of riding an Indian train, Kipling also writes evocatively about people. The novel's young protagonist—"a poor white of the very poorest" living on the streets—and its second great character—an elderly Tibetan lama—are especially finely drawn.

Ned: From the novel's beginning, Kim is a complex character. A beggar in rags, he nevertheless wears an amulet case holding his birth certificate, which identifies him as the son of a British subject. This document will eventually allow him to enter India's colonial ruling class. But the novel's hero already stands at a cultural crossroads: Kim speaks "the vernacular by preference, and his mother-tongue in a clipped, uncertain singsong"; out on the street, where he must manipulate and disarm in order to obtain food and shelter, he is known as "Little Friend of All the World."

Lesley: No one could seem more different from the irrepressible Kim than his serene and often subdued companion, an elderly Tibetan lama. Here is how Kipling describes this stately, unworldly character:

> *He was nearly six feet high, dressed in fold upon fold of dingy stuff like horse-blanketing . . . At his belt hung a long open-work iron pencase and a wooden rosary such as holy men wear. On his head was a gigantic sort of tam-o'-shanter. His face was yellow and wrinkled, like that of Fook Shing, the Chinese bootmaker in the bazar. His eyes turned up at the corners and looked like little slits of onyx.*

Ned: The lama and Kim do make an unlikely pair, but they befriend each other at the beginning of the novel, agreeing to travel in search of a holy river that has haunted the lama's dreams. The older man serves as a parental figure and spiritual guide for the orphaned Kim, offering the boy unconditional love and a wisdom Kim gradually comes to value. At the same time, Kim is so worldly, resourceful, and physically agile that he often seems to be the guide and protector of the lama, helping the old man meet the demands of everyday life.

Lesley: That's an excellent point, Ned. Kim is tremendously precocious. We have discussed several coming-of-age novels in this series, among them *Jane Eyre*, *Great Expectations*, and *Lord Jim*. Each of these books features a protagonist who is innocent and who must come to terms with the world. However, the thirteen-year-old Kim seems worldly from the first page of the book. Kipling's portrait of this youth is unsentimental and surprising.

Ned: It's not that Kim doesn't learn anything in the course of the novel. He gains knowledge, skills, and greater sophistication in his dealings with others. Yet his carefree, adventurous spirit and willingness to put himself at physical risk do not change.

His life changes, though. Kim discovers that his deceased father enjoyed a fairly high rank in the British military, entitling him to the

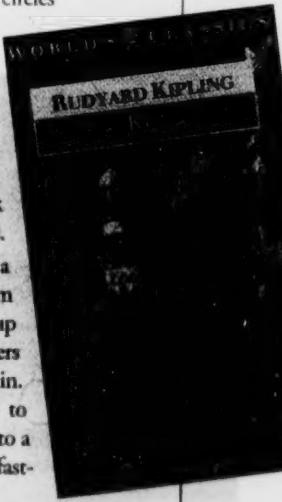
Kim: A Colonial Novel

Rudyard Kipling's *Kim* has always elicited a variety of responses. Many have admired the unique characters of Kim and the lama, the book's vivid evocation of turn-of-the-century India, and its sympathetic portrayal of the task of growing up. However, others have criticized Kim, in part for its apparent acceptance of British colonial domination in pre-independence India.

When Kipling's young protagonist learns that he is linked to the British imperial class within India, he does not renounce his ties to the Indian streets or his former companions. But he does accept and enjoy his new social standing and the opportunities that come with it. When Kim becomes an operative in the world of British espionage, he strengthens his affiliation with India's British elite. He also becomes part of the network devoted to strengthening British power in India.

But does Kim endorse the colonization of India? It is difficult to characterize the book's complex relationship to the Indian world; each reader must evaluate this aspect of the novel for him- or herself. However, some readers have found in *Kim* what the essayist Edmund Wilson termed an "imperialistic strain." While Wilson found *Kim* "almost a first-rate book," he judged that it did not greatly illuminate the human consequences of colonial rule.

Discussions of both colonial and postcolonial literature are commonplace in literary circles today. To put it broadly, colonial literature status of a young *sahib* or master in India. While reluctant to distance himself from the lama, he allows a small group of British soldiers to help him obtain a traditional education. Much later, these men encourage Kim to become an operative in British spy circles in India.



Lesley: While Kim ascends in social status in India, he remains close to the lama, who unexpectedly pays for the boy's British-style education. He also stays at ease among the Indian poor. Kim's life therefore becomes a medley of the Indian, the Tibetan, and the British. I believe that this book never provides an integrated vision of these influences.

The resulting fragmentation bothered me quite a bit while I was reading. The narrative action sends Kim catapulting from a visionary religious elder to a group of sometimes kindly, sometimes buffoonish managers of the British empire in India—and then back again. Perhaps mirroring its hero, the novel itself seems to change identity from a catalogue of Indian street life to a spiritual meditation on achieving transcendence to a fast-paced, wild, and crazy adventure story.

Ned: I agree. Still, it's possible to see the lack of unity as a result of Kipling's ambition in encompassing a world of many cultures, of low comedy and high adventure, and of tragic, touching moments. It is true, though, that other writers have written similarly ambitious works with greater structural and stylistic unity.

Lesley: Nevertheless, the novel sets the reader an interesting task: making sense of the disparate elements of Kim's unusual life.

Kim has his own troubles with the same challenge. "What is Kim?" he asks himself several times in the narrative, with some degree of emotional pain. Kim is usually a light-hearted character who relishes the colorful, patchwork nature of his life. But he is susceptible to moments of anguished self-questioning that add depth to his character and to the novel.

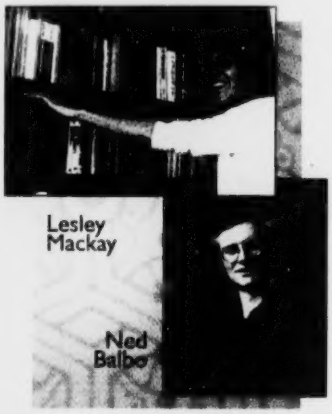
Ned: Absolutely, Lesley. And Kim is not the only character to suffer moments of anguish. Take, for example, the suffering of E-23, another spy in British India's secret service. The part he plays in the world of espionage, or the Great Game, as Kipling calls it, goes horribly wrong.

Lesley: I was moved by the suffering of the lama when he is assaulted on a journey he takes with Kim in the Himalayan foothills. The elderly man traces the cause of the assault back to himself and what he judges to be wrongful pride in his agility and strength in climbing the hills. According to his karmic vision, pride leads the universe to respond with a painful reprimand.

Ned: But these dark moments are not fully integrated into the narrative. E-23, for example, is too easily rescued and then completely disappears from the narrative. And Kipling never requires Kim to face a truly difficult or dangerous situation.

Lesley: I agree. He doesn't challenge his protagonist enough. And so ultimately, while I admire Kipling's energetic powers of description, I do find the book disappointing in some ways. Kipling set himself a great challenge in bringing together characters with such incongruous backgrounds. But I think that his treatment of cultural encounters is often quite superficial. While Kim may, in his moments of crisis, indicate an awareness of the different claims on his identity and loyalty, Kipling could have done more to explore this core issue in his book. Instead, he relies on the adventure-story aspect of his tale, declining to look at the questions provoked by his own narrative.

Ned: I know what you mean, Lesley, and on the whole I agree. On the other hand, I suspect that Kipling was most concerned with depicting the richness of the physical world as this world is embodied by India. With imaginative precision and stylistic mastery, and with the delight of a sensualist, this author recounts the powerful charms of the "wheel of things" from which the lama hopes to detach himself. ■



Ned Balbo holds advanced degrees in writing from Johns Hopkins and the Iowa Writers' Workshop. He currently teaches in the Writing and Media Department at Loyola College in Maryland. Lesley Mackay is IAAY's staff writer.

affirms the world of empire, while postcolonial literature questions that world or depicts cultures that have assumed or are struggling for autonomy. The distinction is not necessarily a chronological one. For example, Joseph Conrad, writing in the same era as Kipling, expressed a much deeper awareness of the tensions and conflicts inherent in European imperialism: Conrad's *Lord Jim*, which was published in 1900 and which we read earlier in this series, casts dark shadows and doubts on its colonial setting.

Kipling most likely began work on *Kim* in 1892 in Vermont. But *Kim* was not published until 1901, sixteen years after the Indian National Congress was formed to advance Indian self-determination.

Recommended reading:

Boehmer, E. (1995). *Colonial and postcolonial literature: Migrant metaphors*. Oxford: Oxford University Press.

Bloom, H. (ed.). (1987). *Kim: Modern critical interpretations*. New Haven: Chelsea House Publishers.

1996-97 series, Literature from Around the World:

- Zora Neale Hurston, *Their Eyes Were Watching God*
- Rudyard Kipling, *Kim*
- ☞ Isabel Allende, *The House of the Spirits*
- James Joyce, *Portrait of the Artist as a Young Man*
- Alan Paton, *Cry the Beloved Country*

STUDENTS REVIEW

DUKE UNIVERSITY

College Review Series

This on-going series is intended to aid prospective college students in their search by offering insiders' views of selected colleges and universities, as expressed by current undergraduates or recent graduates who have exceptionally high academic ability. Note that the number of reviewers is small. Consider their personal perspectives as only one component while you gather factual information and impressions from such other sources as college catalogues, site visits, talks with officials and students on campus, and the advice of your guidance counselor and teachers.

Duke University

Our reviewers include thirteen students who major(ed) in biology (3), biomedical engineering (1), civil & environmental engineering (1), classical studies (1), economics (2), history (1), math (7), mechanical engineering (1), physics (4), psychology (1), and sociology (1). (The number of majors exceeds thirteen because several students have double majors.) Students' comments appear within quotation marks.

Quality of Academic Instruction for Undergraduates

All reviewers expressed satisfaction with the education Duke offers, emphasizing the curricular flexibility and the helpful faculty.

"Excellent; I am very pleased with the education I'm receiving. Students are required to take courses from six different areas that span the realms of knowledge: arts & literature, civilizations, foreign languages, natural sciences, quantitative reasoning, and social sciences. With the exception of the required freshman writing course, the distribution requirements are flexible enough to allow you to take classes you **want** *to take."*

"My professors have been wonderful resources, willing to help me delve deeper into topics that interest me if I take the time to come by after class. The instruction is topnotch, especially in biology, chemistry, history, English, economics, and political science. The only department that is not up to par is computer science."

"Professors range from excellent to bad, but you can usually find several very good professors each semester. Advanced opportunities can usually be pursued since many professors enjoy interacting with students. With few exceptions, most classes have no more than 30-40 students, and many are even smaller, especially higher-level courses. Grading is inflated."

"Opportunities for a well-rounded education are abundant, and the quality of the Duke faculty opens the door to an above-average education. The distribution requirements were valuable; I encountered some subjects I wouldn't otherwise have studied."

"The distribution requirements are fairly easily circumvented; for example, the Philosophy Department's 'Symbolic Logic' and 'Philosophy of Mathematics' are popular ways for math majors to get their Civilizations credits."

"Duke's computer resources are quite good. Not only are the dorms hooked up to ethernet, but there are 88 public-access UNIX stations for students. Moreover, each department has its own cluster of 7–8 workstations. The library system is ample, but not well organized for one-stop-shopping. While there is a main library, the individual department libraries house perhaps one-third of the university's holdings, spreading books out across the campus."

Social Life

Reviewers agree that Duke has a very active campus social life with many friendly students. The university administration recently initiated several changes, such as banning keg parties, in an effort to alter Duke's traditionally alcohol-intensive, fraternity-dominated social life. The social life nonetheless remains very spirited.

"Duke's social life is definitely focused on campus. Weekend events include theme parties, frat parties, dances, sports tournaments, and other opportunities like movies. The housing contributes to the social scene; the quads are ideal for concerts and other events that bring people together. In general, while there are some students (mostly premeds) who spend the weekends studying, the student body as a whole is very socially active. Feelings of school pride run high here (Duke basketball—need I say more?)."

"The social life used to center around keg parties. After the administration banned them, Duke initially seemed to lose some of its pizzaz. Last year, however, with a decent basketball season, it was once again as fun as ever."

"Some people complain that there's nothing to do on Friday and Saturday nights that doesn't involve getting drunk, but I don't think they're looking hard enough. There are always concerts, movies, and plays on campus that are either free or very affordable. There' are organizations devoted to just about anything imaginable, but many of them require huge time commitments, so it's difficult to dabble."

"Upperclass housing includes theme dorms, which, like fraternities, are selective. This system allows you to live with people who share your interests even if you do not join a fraternity/sorority. Within this array of socially distinct environments, it's easy to find a niche."

"Duke has a number of advantages over other schools of its reputation. About 95% of the students live on campus for all four years, providing an excellent atmosphere for dinner conversations and late night talks with hallmates. And the weather and environs are superb—plenty of opportunity for running, biking, hiking, frisbee, or contemplation in the gorgeous Duke gardens and forests."

"Durham isn't much of a college town; it's a relatively quiet, relaxing place with few social opportunities. Those seeking the boons of city life will find it a disappointment. However, Chapel Hill, with its fairly lively night scene, is only ten minutes away by car."

"Duke is not a typical southern school; the student body is much more national—New York and New Jersey are well-represented. Individuals who are initially apprehensive about going to a southern school quickly come to love it here."

What Do You Like Least about Duke?

The relaxed, friendly atmosphere topped the list.

"The fact that I'm getting a great education and enjoying friends, a beautiful campus, and great weather all at the same place."

"The chance to explore my interests in a relaxed atmosphere. If you take the time and effort to ferret out opportunities, they are there."

"Definitely the laid-back atmosphere. It may be different among the swarms of premeds, but I don't feel any pressure to compete for grades, or for anything at all, for that matter. Almost no one is obsessed with maintaining a 4.0 for its own sake, although plenty of people are eager to learn."

"I love how stress-free Duke is. The night before the organic chem final, we were out playing football until 2:30 a.m. You won't find that at many other universities."

What Do You Like Best about Duke?

Nearly all reviewers focused on the social life in responding to this question. Some are in favor of the changes the college president has tried to make; others strongly oppose them.

"The drinking. With the banishment of keg parties, it's gone down. Yet there still seems to be an inertia to organize get-togethers without the inducement of large quantities of alcohol."

"Too much of an anti-intellectual attitude. Social life is overwhelmingly alcohol-based."

"The administration is trying to turn the university into Harvard; they think Duke is not intellectual enough. The president and her cronies all have Ivy envy. None of the students do. Most students got into Ivy League schools and turned them down to come to Duke. The administration doesn't understand that Duke students are brilliant, but didn't come to college just to study. Needless to say, the administration is very unpopular among the students."

"The fact that the president of the university is trying to make Duke more like an Ivy League school by stressing academics and playing down athletics. I know it sounds silly, but one of the best things about Duke is the school spirit and unity. With less focus on athletics, the school will lose a lot of that unity."

Who Would Be Most Compatible with the Academic and Social Atmosphere at Duke?

"The words 'sociable,' 'outgoing,' and 'gregarious' come to mind."

"Someone with initiative. The best experiences come when people set out on their own and discover all that Duke has to offer—and that's a **lot.***"*

DUKE UNIVERSITY

Durham, NC 27706
(919) 684-3214

- 4-year private coed university
- Duke has two campuses a mile and a half apart; free buses run regularly between them. The West Campus's beautiful architecture has earned it the nickname of "the Gothic Wonderland."
- Full-time undergraduate enrollment 1996-97: 3,185 men; 2,991 women.
- Special features: 55-acre Duke Gardens and 7,700-acre Duke Forest. Primate Center, world's largest colony of endangered primates and the only university-based facility devoted to study of primate behavior. Blue Devils, nationally ranked men's basketball team.

"Someone who is very smart but would never brag about it, happy to hang out talking until 5:00 a.m. even though he or she has a class at 8:00 a.m., not a computer geek, and capable of serious partying."

"There's no such thing as an ideal Duke student—there's such a diversity of attitudes towards learning. To get the most out of a Duke education, you should be motivated enough to do more than is needed to just get by, but should not allow your life to revolve around your GPA."

"This is a difficult question because Duke has a 'split campus': those who just get by (not difficult to do) and those who take academics seriously. While there are more than a few of the latter, the most prevalent attitude seems to be one of leaving academics in the classroom and not appearing overly studious."

"Someone who can budget time well. There are so many opportunities to be socially active here that you can have a problem if you don't. Many students are 'closet studiers'—if you didn't know better, you'd think hardly anyone at Duke studied. In fact, almost everyone studies hard; they just manage their time well and study during odd hours—at midday or after midnight."

If You Had It to Do Over Again, Would You Go to Duke?

Despite the qualms expressed about Duke's social life, all reviewers said yes, most with great affection and enthusiasm.

"Without hesitation. I love this place. I wouldn't even look at any other schools. Everything I wanted to get out of college academically and socially I did."

"YES! I love Duke, the atmosphere, and my fellow students. I am proud to be attending Duke. The only downside is that time tends to fly; before you know it, you're a junior."

"I had a great time at Duke and grew immensely in my four years there, finding plenty of opportunities to be challenged and stretched. My peers were of a wide variety: philosophical, thoughtful, humorous, athletic, kind. I have no reservations about recommending it."

"Yes. The administration is making changes that some people see as messing with the status quo, but that are probably better categorized as not resting on one's laurels. Both advocates and detractors of these changes are overstating their cases: the changes are neither visionary nor apocalyptic. I think the changes are sound, and I don't think the flavor of the school that makes it so appealing will be lost."

As you try to find the college or university best suited to you, the views of Duke presented above may be helpful. Keep in mind that these students might have had similar positive or negative experiences had they attended a different university. At any college, it is important to seek out challenging academic experiences and the best professors and to create a social life that fits your personal style. ■

Note: The students quoted in the College Review Series are expressing their own views, which are not necessarily those of JHU or IAAY.

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ImaGiNe...

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Why I'm Addicted to Baseball

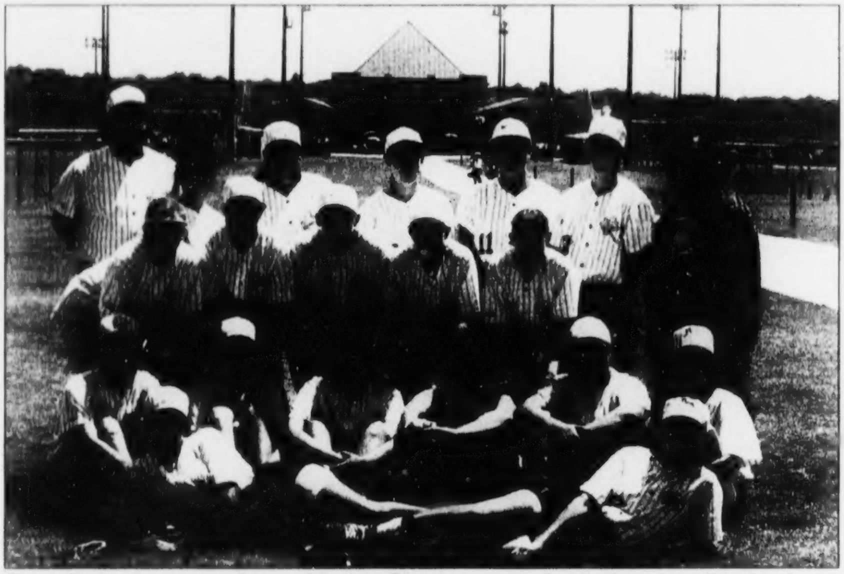
by Carly Milner

the ball is everything as it rises
every eye every hand every shout
every pumping muscle every heartbeat
looks to the ball having watched
it from the tip of the fingers to the
collision with the bat and to
wherever it goes it is gut wrenching
it is love it is hate it is fear it is confidence
all at once and never again
but, slowly; and perfectly; and dignified.

It is not a deception or adrenaline or
a common rush.
It is not fumbled or intercepted or
crushed between turf and flesh.
It is not roughly pushed into a
net or thrown around like a wad
of dirty laundry.

because

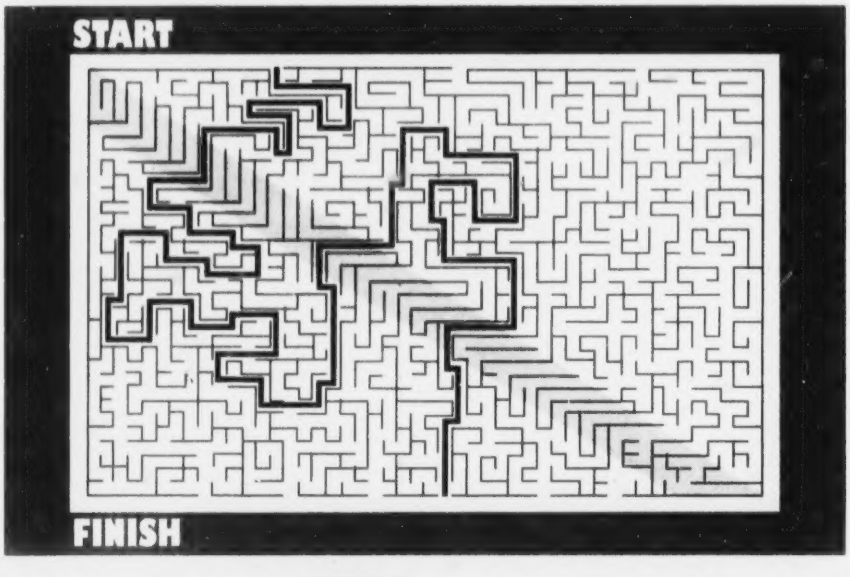
the ball is everything as it rises
it is beautiful
it is serene
it is done and there is no recall
no second chance no time for
instructions it is gone with the
swing and wherever it goes whatever
happens it is done but no one
knows
no one knows so it matters but it
is done; and it is beautiful.



*This softball team is one of many for which Ellen Hempler, a friend of the poem's author, has played. Being less athletic than Ellen, **Carly Milner** enjoys watching and writing about the game more than playing it.*

SOLUTION TO PUZZLE IN SEPTEMBER/OCTOBER ISSUE

by Tenie Remmel



VOLUME 4 • NUMBER 3

Imagine...

Opportunities and Resources for Academically Talented Youth

January/February 1997

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Published by the Johns Hopkins University Press for the JHU Institute for the Academic Advancement of Youth

Spotlight On

EXPLORING THE UNIVERSE THROUGH PHYSICS AND ASTRONOMY

Astronomy students search the stars at dusk during the IAAY/CTY '96 summer program at Franklin & Marshall College in Lancaster, Pennsylvania.

photo by Vilma Lonsdale

From the beginning, humans have posed questions about the workings of the world and its universe. In physics and astronomy, such questions are constantly being refined and reformulated at newer, more ambitious levels. These sciences provide the concepts, vocabulary, and tools with which to explore the nature of the physical world, from the smallest imaginable particles to the vast expanse of space.

In this issue of *Imagine*, we hear from people who are excited by such investigations. A cluster of astrophysicists tell how they got hooked on space. A young researcher talks about the range of intriguing subfields within contemporary physics. Two students describe their adventures at U.S. SPACE CAMP. Profiles of internships, in-school programs, and Web opportunities suggest ways you can get more involved in physics and astronomy.

Additional articles include a sampling of 1997 summer programs, a career profile of a planetary scientist, a calendar to help you prepare for college, and our array of regular features. We hope that this issue of *Imagine* will propel you into an expanding universe of discovery. ✱

MARK YOUR CALENDAR

with these registration deadlines for selected academic competitions. Inquire about competition format, dates, and fees.

DEADLINE	COMPETITION
February 20	**NATIONAL FEDERATION OF PRESS WOMEN HIGH SCHOOL JOURNALISM CONTEST**—Individuals submit entries through state affiliates, grades 9–12; *some state deadlines may be earlier:* NFPW Headquarters Office, 4510 West 89th Street, Suite 110, Prairie Village, KS 66207; (913) 341-0165, fax (913) 341-6912.
March 15	**USA Computing Olympiad Competition Round**—Grades 9–12: Dr. Donald T. Piele, University of Wisconsin-Parkside, Kenosha, WI 53141; (414) 595-2231, piele@cs.uwp.edu; http://usaco.uwp.edu
April 2	**Knowledge Master Open**—Schools enter one team each for middle, junior high, and high school divisions: Academic Hallmarks, Box 998, Durango, CO 81302; (800) 321-9218 or (970) 247-8738; fax (970) 247-0997.
May 1	**American Regions Mathematics League**—Teams register for national competitions held at Penn State and Universities of Iowa and Las Vegas; grades 7–12: Mark Saul, ARML President, 711 Amsterdam Avenue, New York, NY 10025; (212) 666-5188.
May 15	**USA Mathematical Talent Search (USAMTS)**—Individuals enter for 1997–98 school year (collaboration between the Consortium for Mathematics and Its Applications and the National Security Agency): Annette Moccia, COMAP, Inc., Suite 210, 57 Bedford Street, Lexington, MA 02173; (617) 862-7878 x29.

Want to subscribe to *Imagine?* Call (410) 516-6989 or (800) 548-1784 and ask about our introductory price.

COMING ATTRACTIONS: *Imagine's* March/April 1997 issue will focus on "Navigating Our Global Society." Contents will include a student review of Dartmouth College.

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I certify that the statements made by me above are correct and complete. Marie R. Hansen, Associate Director.

Imagine...
*Opportunities and Resources for Academically Talented Youth**

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THE ATTRACTIONS OF PHYSICS

by Michael Yoo, Ph.D.

Sometime between my twelfth and thirteenth birthdays, I announced that I wanted to be a physicist when I grew up. Earlier choices of fire fighter and police officer had faded as I outgrew my fascination with loud sirens and flashing lights. Still, why not doctor or business tycoon or athlete? What made me choose physics?

I suppose I thought of Galileo looking through his telescope, or Isaac Newton pondering falling apples, or Albert Einstein pedaling on his bike across the Princeton campus, hair flying in his trademark mop. These were people whose curiosity—and perseverance in trying to understand the things that piqued their curiosity—changed the course of science forever.

My first exposure to physics came at about that time through an astronomy book given to me by a family friend who was an astrophysicist. This was the first book I had ever read that really addressed the questions I wanted to ask. I didn't need to know the shapes of the constellations or the myths that spawned their names. I wanted to know what the stars were made of, what made them shine, how they were born from interstellar dust, why some fizzled into white dwarfs while others blazed into supernovas.

I remember thinking that discovering the answers to questions like these would be a great job for a grownup. It seemed to me that physicists tried to figure out what makes the world work, contemplating questions of *how* and *why* much more seriously than most people did. They could reveal the inner workings of nature the way a watchmaker could pick apart the springs and gears of a clock.

This is what I thought as a twelve-year-old.

Fast Forward

You've probably guessed by now that I did grow up to be a physicist. And I was right about it's being a great job.

At twelve, I was certain I was going to be an astrophysicist. Then, when I was in high school, I saw the mile-long beam lines and warehouse-sized detector arrays at Fermilab and was suddenly hooked on particle physics. A series of fantastic courses I took during college made it clear that physics was more than just a childhood whim, but also made it harder to me to choose a specialty. High energy physics and astrophysics still seemed fascinating, but now so did atomic and solid state and plasma physics. By the time I finished graduate school, the thrill I got from building instruments with my own two hands told me that I was destined to be an experimental—not theoretical—physicist.

Today I am a condensed matter experimental physicist. I study and build new semiconductor lasers only as big as the eraser on the end of a pencil. Every day, I try to answer the kinds of questions that got me hooked on physics more than a decade ago: How do we grow crystals of our laser materials, zinc selenide and gallium nitride? What are their fundamental electrical and optical properties? Will they emit laser light? Why do some lasers fail?

In a few years, after these questions have been answered, I'll probably be studying a different problem. Perhaps I will be investigating new magnetic materials or building microscopes that can look at individual atoms. But I know I will be having fun because I will still be trying to figure out how nature works.

From 10^{-15} to 10^{21} Meters: The Scope of Modern Physics

Today's physicists explore aspects of nearly everything in the world around them. Their fields of investigation range from the subatomic to the supragalactic, spanning more orders of magnitude than any other discipline:

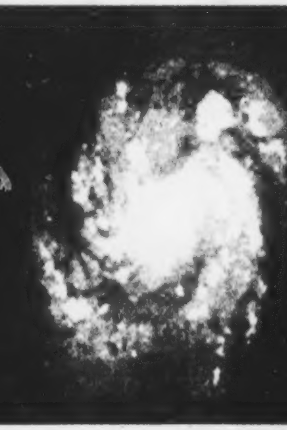
- *High energy physicists* working at beam colliders, like CERN in Geneva or Fermilab in Chicago, study the fundamental particles (quarks and leptons) and forces that make up matter.
- *Nuclear physicists* try to understand what happens inside the protons and neutrons in the nuclei of atoms, while atomic physicists investigate the behavior of atoms. These physicists developed the first lasers and atomic clocks.
- *Condensed matter physicists*, like me, study collections of atoms. If this description seems vague, it is because condensed matter physicists study a huge variety of topics, ranging from the behavior of gases and liquids near absolute zero (the winners of this year's Nobel prize studied liquid helium-3) to the semiconductors in the latest computer chips to the behavior of soap bubbles and sandpiles.
- *Biophysicists* are just now beginning to really understand the behavior of cells and their components. Physicists have also played central roles in developing powerful imaging technologies like magnetic resonance imaging (MRI).
- *Plasma physicists* use huge reactors called tokamaks to try to capture here on Earth the same fusion reaction that drives the Sun. Ultimately, they hope to develop fusion as the energy source of the future.
- And for those interested in really large scales, *astrophysicists* and *cosmologists* explore the night skies and try to understand the origins of the universe.

Whatever the subfield, I think the great appeal of physics is that it is a never-ending struggle to understand nature. It teaches us to look analytically at the world around us, from the inner workings of a proton to the inertia of a speeding truck (a vital real-life physics problem!) to the transmission of light through an optic fiber.

Whether you plan to get your Ph.D. in physics or just take a class or two in high school and college, I hope you will be touched by the magic I have found in physics. And I hope you will learn to think deeply about our world and to ask, "What *really* makes that work?"

Michael Yoo is a 1980 talent search alumnus. After a decade in Cambridge, Massachusetts (A.B. at Harvard, Ph.D. at MIT), he spent two postdoctoral years at Bell Laboratories. Michael is currently a senior member of the research staff at Philips Laboratories in New York.

Seven Astrophysicists Share Their Stories



"When I was in second grade, I asked my father to explain a picture in my *Golden Book of Astronomy* illustrating Newton's Third Law. He encouraged my youthful fascination and later took me out to look at the night sky with a 2.4-inch refractor lens. Gazing up at the rings of Saturn and the Orion Nebula, I was convinced I had found my career.

"After completing an undergraduate degree in astronomy, I fulfilled an astronomy junkie's dream: I studied a black hole. Well, a black hole candidate. My doctoral research at Goddard Space Flight Center involved analyzing variations in the X-ray emissions from the black hole candidate Cygnus X-1. Such studies help us explore the evolution and interactions of matter in the universe.

"For my postdoctoral work, I went to Los Alamos National Laboratory (big sky!), where I continued to study the variability of X-ray sources. Now back at Goddard, in addition to doing my own research, I enjoy helping other researchers interpret their data from the X-ray Timing Explorer (XTE) satellite. Every so often, though, I get homesick for the Southwest—the small towns, the open spaces, and the dark night skies."

__Jim Lochner__ is a research scientist at Goddard Space Flight Center's XTE Guest Observer Facility. In his spare time, he enjoys collecting and telling star lore tales from mythology and Native American traditions.

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"For many years, I studied to be a ballet dancer. While I loved looking through a telescope when I was little, it wasn't until my junior year in high school that I became interested in studying astronomy with the goal of becoming a scientist. I hadn't taken all the courses other future scientists had, so to bring myself up to speed, I took math and physics in summer school.

"In college, I spent a lot of time on the roof, learning the constellations and watching for meteors. I studied physics in graduate school, then came to Goddard where I'm a member of the Monitoring X-ray Experiment (MOXE) team. My main interest is in analyzing data from astronomical objects to search for periodic and non-periodic variations. Such data can tell us about the dynamic interactions taking place within those objects. I find my work exciting and challenging and enjoy the opportunity to continue to learn new things while doing my research."

__Padi Boyd__, a research scientist at Goddard's Universities Space Research Association, also enjoys a cappella singing.

◆ ◆ ◆

"In the industrial town in the north of England where I grew up, the air pollution was so bad that you could rarely see the stars. So I first became interested in stars by seeing them on TV (not *always* a bad influence). I read all the books I could find on astronomy, and by age nine I had decided to become an astronomer.

"I attended University College London, the only English university that offered a major in astronomy. I dreamed of becoming an astronaut and walking on Mars one day, so I did my doctoral research about Mars, using data from the *Mariner* and *Viking* spacecraft. To my dismay, when I finished my Ph.D., I found that British universities thought the two people they already had studying Mars were enough. I realized I'd have to be flexible if I wanted to stay in astrophysics.

"I came to the U.S. shortly before Comet Halley made its most recent appearance and was delighted to be able to share the comet's passing with my infant daughter (who was probably too young to appreciate the event). I'm now trying to solve the mystery of gamma-ray bursts using data from the Russian gamma-ray detector, *Konus*, the first Russian instrument to fly on an American spacecraft. I like everything about science and wish everyone could have a chance to share the excitement."

A scientist and software engineer at Goddard's Laboratory for High Energy Astrophysics (LHEA), __Paul Butterworth__ still sometimes dreams of walking on Mars.

◆ ◆ ◆

Photograph of the spiral galaxy M100 taken by the Hubble Space Telescope. Courtesy of NASA. For more on this photograph, see http://antwrp.gsfc.nasa.gov/apod/ap960713.html

"When I was home sick one day in third grade, I read a book about the possibility of life on other planets. Fascinated, I asked my parents to buy me a small telescope to observe the Moon and planets. I also loved to build things and do experiments. Such activities were considered inappropriate for girls then—it was the '60s, before the women's movement—but I didn't care.

"I took the hardest math and science courses in high school, then studied physics at MIT. In the summer of 1973, I worked on Nantucket Island at the Maria Mitchell Observatory, named after America's first woman astronomer.

"Later, I completed a Ph.D. in astronomy at Cornell, where I was the first woman in the department to have a child while in graduate school. Since 1983, I've been at JPL. Like many in this field, I've known disappointment when a project I was working on was dropped due to budget cuts. I'm now working on the development of the Cassini mission to Saturn, scheduled for launch in October 1997. I have a real appreciation for the good sound advice of my doctoral advisor: Have faith in yourself, avoid distractions, finish what you start, and press on regardless."

__Bonnie J. Buratti__ is a research scientist in the Division of Earth and Space Sciences at the Jet Propulsion Laboratory. In addition to doing research and teaching, she is raising three children.

* * *

"I grew up near Osaka, Japan, and was interested in physical sciences and astronomy from a young age. I am indebted to my older brother who shared his precious copies of *Sai-en-su*, the Japanese version of *Scientific American*, with me.

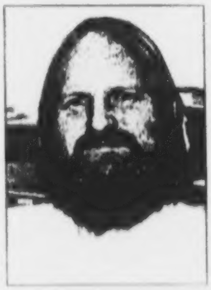
"After completing my undergraduate education in Japan, I moved to Oxford to do my graduate work on cataclysmic variable stars—a dramatic name for a fascinating phenomenon: a binary star system in which two stars, one much like our own Sun and the other a white dwarf, orbit around each other. Powerful gravitational forces from the white dwarf draw matter from the outer layers of the normal star. Gas accumulated on the white dwarf's surface may start a nuclear fusion chain reaction, creating what is called a classical nova outburst.

"At Goddard, I'm part of a Japan-U.S. joint project, called ASCA, to study the X-ray spectra of astrophysical plasma and distant quasars. My fluency in Japanese and English—especially in highly technical vocabulary—is a great asset to the project. In addition to my own research, I help other researchers track down problems they may have with ASCA systems, adding a very enjoyable puzzle-solving component to my work."

An accomplished pianist and science fiction fan __Koji Mukai__ is a research scientist at Goddard's ASCA Guest Observer Facility.

"Growing up on Fox Island in Puget Sound in western Washington State, I developed a great appreciation for mountains, oceans, and forests. After completing the usual twelve years of schooling and reading far too many science-fiction books, I attended the University of Washington, where I majored in physics, math, and astronomy.

"Not yet ready for the real world (no doubt a mutual feeling), I went to graduate school at the University of Wisconsin. After slightly more than the usual number of years of study—and six months spent backpacking through Europe—I got my Ph.D., developing a model of the distribution of emission responsible for the diffuse X-ray background in the galaxy. Since completing my Ph.D., I've continued to study the low-energy diffuse X-ray background. Such data are proving to be exceptionally important in providing insight into the interstellar medium, the galactic halo, and general galactic structure."



Finally ready for prime time, __Steve Snowden__ is an associate research scientist at the Laboratory for High Energy Astrophysics (LHEA), where he works with the ROSAT project. ROSAT, an orbiting observatory which images X-rays, is a joint German, British, and U.S. collaboration.

* * *

"I always did well in math and science, but I was afraid of physics and did not really come to enjoy it until I was in college. My older sister, who has a Ph.D. in statistics, was a great role model for me. A lot of other people tried to steer me away from math and science, but she supported my interest. My mother wanted me to become a flight attendant so that I could travel. I found a different way to fly.

"I now travel to telescopes around the world. For me, a typical day is actually a night: observing all night, sleeping for a few hours, then looking at last night's data to plan the strategy for the coming night's observations. After an observing run, I return home to analyze my data. My two children, whom I adore, are now old enough—seven and nine—to understand much of my work. Sharing my excitement and sense of discovery with them is a great joy.

"Someone once asked me to complete the sentence 'I am ___' with the first thing that came to my mind. I was 14 at the time, and I immediately said, 'A very determined person.' As the years have gone by, I've thought back and realized that, had it not been true, I would have opted out long before I reaped the benefits of staying in the game. I love what I do, and I'm so glad I'm doing it."

__Yvonne Pendleton__ is an astrophysicist at NASA Ames Research Center. When not visiting distant telescopes, analyzing data, or spending time with her children, she is the resident astronomer at her children's school, giving demonstrations and answering questions posted to "The Astronomer's Mailbag."

✱

Photograph of the rampaging fronts of the veil Nebula taken by the Hubble Space Telescope. Courtesy of NASA. For more on this photograph, see http://antwrp.gsfc.nasa.gov/apod/ap960307.html

KIDSAT

Students Exploring Earth from Space

by Mark Jones and Lesley Mackay

***KidSat Partners:** The KidSat program is a joint project of the Jet Propulsion Laboratory, The Johns Hopkins University Institute for the Academic Advancement of Youth, and the University of California at San Diego, with technical assistance from NASA's Johnson Space Center. The project is supported by NASA's Office of Human Resources and Education, with the cooperation of NASA's Offices of Mission to Planet Earth, Space Flight, and Space Science.*

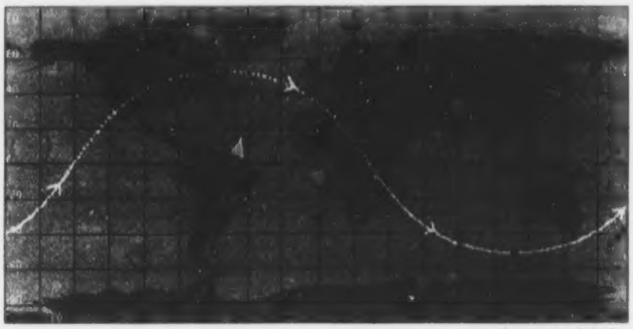
Wouldn't it be fun to hitch a ride on a Space Shuttle flight? A growing number of students are doing that. Well, almost.

This January, NASA will launch its 81st Shuttle mission, the 18th voyage of the *Atlantis*. On the second day of orbit, a camera programmed by a team of students, engineers, and teachers will be hooked up to a computer that is linked to others on the ground. In the moment that the computers are connected, hundreds of students will virtually board the flight.

Students will make this leap by way of KidSat—an educational project that gives them exclusive access to a spaceborne camera that will take hundreds of images of Earth from space. KidSat's rigorous and rewarding preflight, flight, and post-flight activities are currently divided among preselected middle school, high school, and college students. But anyone can learn more about this project and explore its store of space-generated images of Earth at the KidSat Web sites (see box on next page).

Student Mission Operation Centers

Much of the action in the developing KidSat project currently takes place in Student Mission Operation Centers in fifteen pilot schools around the country. At these centers, KidSat middle schoolers choose the images to be taken during the upcoming mission. Depending upon a flight's particular orbit patterns, they may pinpoint volcanoes, glaciers, or stretches of scorched earth; or they may capture broad expanses of ocean, coastline, or continental plains. The possibilities are almost endless.



Courtesy of KidSat

Flight Path *During preflight training, KidSat students use Shuttle orbital trajectory maps like this one to identify points of interest beneath the Shuttle's orbital path.*

Courtesy of KidSat

Kangaroo Island *The passage between Yorke Peninsula and Kangaroo Island, Australia, is part of the route navigated by Captain James Cook. KidSat students interested in history chose to photograph this site, where abandoned European outcasts formed early colonies.*

Before they choose their images, the middle school students learn a great deal—about orbital mechanics, the shuttle's movements, and the Earth's terrain. These preflight activities enable them to determine points of interest in the regions over which the Shuttle will pass. During the flight itself, they then closely track the spacecraft's movements, consider weather and other factors, and select their final targets.

After the mission, the students use the images in KidSat Exploration Lessons in areas such as science, math, geography, and environmental studies. They also employ the remotely-sensed snapshots to make quantitative analyses: for example, using a variety of tools, students can measure the size and dimensions of rivers, lakes, coastlines, and landforms.

Mission Control Gateway

Teams of high school and college students staff KidSat's Mission Control Gateway, located at the University of California at San Diego. These students develop and maintain the technological and communications link between the middle school sites and the flight controllers at Johnson Space Center in Houston, Texas. After the Gateway teams check the coordinates of image requests for accuracy, they transmit the commands to Houston and monitor the image-taking process.

The high school students also work in a variety of targeted areas. A *space team* programs the KidSat camera and software and trains the astronauts in their use. A *data team* works on transmission of data and creates applications for the data captured in each snapshot. An *exploration team* brainstorms, develops, and communicates educational applications for each mission's array of visual images. Finally, a *public relations team* works with the media to encourage informative coverage of the KidSat component of the Shuttle flight.

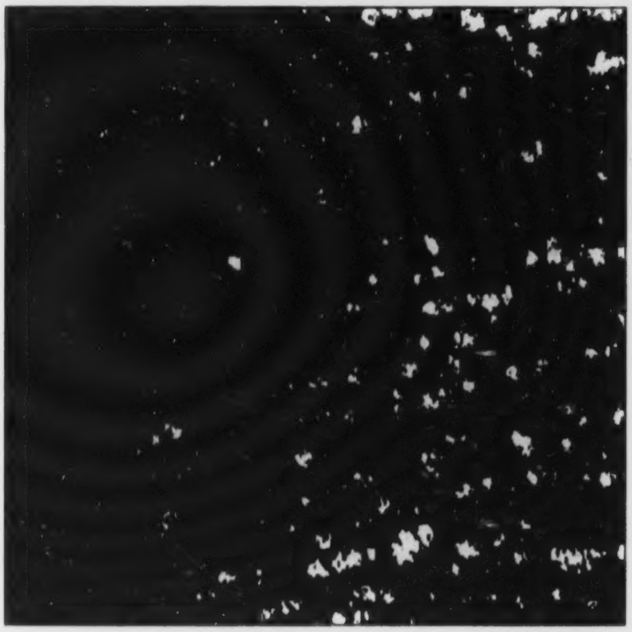
Kelly Winters, an 11th grade student at La Cañada High School in California, is a member of the KidSat space team for the January 1997 flight. Kelly is excited that, in her contribution to KidSat, she is "working on the cutting edge of technology." She explains, "I've been helping to develop the KidSat Web page and to program the camera, computer, and software to be flown in the Shuttle."

Moon-Young Choi, a 10th grader at La Cañada, participates on the public relations team. "During the mission," she tells us, "I will be helping to keep the press and public informed about KidSat. I will also be developing fly-bys—digitally made videos that simulate the experience of flying in three-dimensional space through areas captured by KidSat photographs."

While educational applications like fly-bys are being developed for general public use, KidSat images are already being used by students and teachers in classroom instruction. IAAY is currently developing curricula that will utilize these images in an array of subject areas.

Courtesy of KidSat

Ancient World *This oblique view of the eastern Mediterranean Sea, including the Nile Delta, is a student favorite. Its expanse covers sites that cradled several great ancient civilizations.*



Courtesy of KidSat

Brazilian Rainforest *KidSat students found this image's evidence of destruction of the Amazon rainforest quite disturbing. Under scattered white clouds, the rectangular lighter patches indicate widespread deforestation.*

How have students been responding to KidSat so far—to the exciting pre-mission and mission phases of the project, and to receiving their own images back from space? One KidSat teacher comments, "These students now have a whole new way of seeing the world. When they read or hear about some place, it is no longer an abstract location; it is a place that's real. Even if they haven't taken a picture of that particular location, the experience of KidSat makes the whole world more real for them." ✸

Dr. Mark A. Jones *is now completing an M.A. in Education Administration at California State University, Los Angeles. He is IAAY's program coordinator for the KidSat and CASDE projects.*

KidSat Web Sites

KidSat home page
http://www.jpl.nasa.gov/kidsat/

KidSat Mission Operations home page
http://www.kidsat.ucsd.edu/kidsat/

Orbital Mechanics tutorial
http://www.kidsat.ucsd.edu/kidsat/lessons/Chap.6/contents.html

For additional images of Earth from space, see this NASA Web site:
http://ersaf.jsc.nasa.gov/sn5.html

CASDE: Making Space Data Accessible

The Consortium for the Application of Space Data to Education (CASDE) was created to organize, enhance, and distribute NASA analytical tools—like KidSat data—to students and educators worldwide. These unique resources can add to the excitement of adventures in science, mathematics, history, geography, and other fields. CASDE is jointly led by Caltech's Jet Propulsion Laboratory and the University of Nebraska-Lincoln's CALMIT. Other partners include NASA Goddard Space Flight Center and IAAY.

Check out the CASDE Web site:
http://www.casde.unl.edu/casde/welcome.html

Taking Off at U.S. SPACE CAMP

by Christopher Mihelich

Last year, I won a trip to U.S. SPACE CAMP as a prize for being on the winning team in National MATHCOUNTS 1995. My whole team received free transportation and tuition to U.S. SPACE ACADEMY Level I, a five-day program for 7th-9th graders held at the U.S. Space & Rocket Center in Huntsville, Alabama.

One of the first things you notice when you arrive is the extensive camp layout. Among its highlights are a museum devoted to the history and projected future of space flight and several simulation devices, including a centrifuge chamber and section mock-ups of a Space Shuttle. Scattered around the grounds are rockets used in earlier space programs, and at one end are the Habitat buildings where campers live.

To start with, we were organized into teams of about sixteen members each. My MATHCOUNTS teammates and I were placed on the same team—which proved a significant advantage for us because each team functions as a unit in the competitions.

Establishing a Lunar Outpost

The Lunar Outpost contest requires each team to produce a plan for a permanent settlement on the Moon. We were allotted design time, visits to a computer lab, and opportunities to construct models of robots to be used at the outpost. In just a few days, we had to produce a detailed plan that included layout, tasks members would perform, and means of obtaining food and oxygen. Finally, we presented our plans to the judges.

My team's chances in this contest were greatly improved by Richard Reifsnyder, the MATHCOUNTS '95 individual champion. His specialized knowledge led to ideas about how to extract resources from the lunar soil and produce oxygen indefinitely. Richard's first drafts of the base layout—precise, inclusive, and nearly perfect—really inspired us. When he spoke at the final presentation, the judges' jaws dropped in astonishment. [To understand why, see Richard's plan on the facing page.—Ed.]

Simulating Shuttle Missions

Although the Lunar Outpost contest was a significant (and for our team, highly successful) undertaking, the two mock Space Shuttle missions are definitely the central focus of SPACE ACADEMY.

Prior to a mission, each team divides up the positions: ground control, navigation crew, and mission specialists. An extensive script provides a timetable and detailed description of what the team members must say and do.

However, completing the mission is not as simple as following a script. First, mission specialists receive their instructions and materials for experiments only when they enter the Shuttle; they have to complete the experiments and answer questions about their results. Second, although the script tells the other team members how the mission *ought* to proceed, devious SPACE ACADEMY employees monitor the mission and cause things to go wrong, sometimes several at once. Efficient teamwork between mission control and the shuttle pilots is crucial in dealing with these crises—especially when the entire caution-and-warning panel lights up, as happened on one of our missions. Failure to respond properly can cause the mock Space Shuttle to "crash" and the team's rating to be torpedoed.

Back to Earth

Our team avoided making any fatal mistakes and won the award for Best Mission. A team is prohibited from winning more than one contest; since Best Mission is the more prestigious award, we did not win Lunar Outpost.

With this entirely positive review of SPACE CAMP, I might leave the reader expecting five-star accommodations. So I should mention the less-than-gourmet cafeteria food, low water pressure in some showers, and strangely rubberized beds and pillows. Despite these minor complaints, however, I give SPACE CAMP an unhesitating thumbs-up. ✸

__Chris Mihelich__, of Carmel, Indiana, is a 10th grader at Park Tudor School. He is interested in pure mathemathics, particularly number theory; he also plays piano and flute, composes music, and dabbles in computer programming.

Space travel fascinates all of us, young and old. We watch TV images of astronauts floating free in a Space Shuttle or looking down at our blue green planet as they orbit through another sunrise/sunset, and we wonder what it would be like to be up there, too—if only for a moment.

Recreating spectacular experiences like these is part of what makes U.S. SPACE CAMP such an exciting environment for learning. The three main programs that fall under its umbrella name—SPACE CAMP, SPACE ACADEMY, and AVIATION CHALLENGE—operate through a unique collaboration of NASA, the military, aerospace-related industry, and professional educators. Their purpose is to enhance interest and success in math and science.

U.S. SPACF CAMP programs take place at the U.S. Astronaut Hall of Fame/U.S. SPACE CAMP complex in Titusville, Florida, and the U.S. Space & Rocket Center in Huntsville, Alabama. The hands-on education in space and aviation technology includes astronaut training, team problem solving, flight simulations, and even the joys of "space food." Missions vary from two to eight days and are offered year-round to students, families, and corporate groups.

U.S. Space & Rocket Center
One Tranquility Base, Huntsville, AL 35807, (800) 63-SPACE.

"Through state MATHCOUNTS, I won trips to SPACE ACADEMY two years in a row. I especially enjoyed the simulations when we dressed as astronauts and used equipment to create space travel illusions—like the ⅙th Gravity Chair that lets you jump around as though you're walking on the moon." —Hannah Eucker, Wichita, KS

This SPACE CAMP alumnus presents this "second draft" of the design project he worked on for the Lunar Outpost competition at U.S. SPACE CAMP.

Project Diana, the Lunar Base

by Richard Reifsnyder

People talk of Mars as being the first new planet for humans to explore, but humans have already visited another planet—Luna. Compared with other moon-planet ratios, our Moon's diameter is close enough to that of Earth for the Earth-Moon system to be a double planet. We have the mineral resources of an entire planet only three days away; we can make use of them with Project Diana.

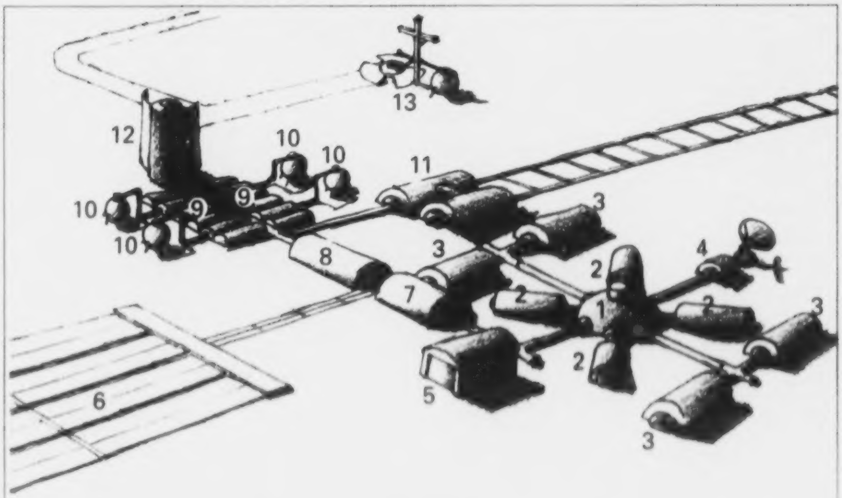
In Roman mythology, Diana was the goddess of the Moon and the sister of Apollo. So it seems fitting that the Apollo project of frontier exploration be followed by the Diana project of colonization.

In Project Diana, a heavy-lift launch vehicle such as the Russian *Energia*, can be used to lift modular components on a one-way course to the Moon. A few hundred-ton rockets are sufficient to land three or four astronauts, along with a smelter to process lunar soil into oxygen and metals such as aluminum, magnesium, and titanium. With these elements, the outpost can expand into a village of one hundred people.

A twenty-megawatt solar array powers both agricultural modules for growing food and recycling the air and industrial plants for smelting thousands of tons of soil per year. Some of the power is stored in fuel cells; during the two-week lunar night, industry ceases and the workers retire to the command dome and habitat modules until the next two-week day. With additional power modules, construction will begin on an electromagnetic rail-gun to launch payloads cheaply; until then, the colonists depend on Earth's hydrogen to fuel chemical rockets.

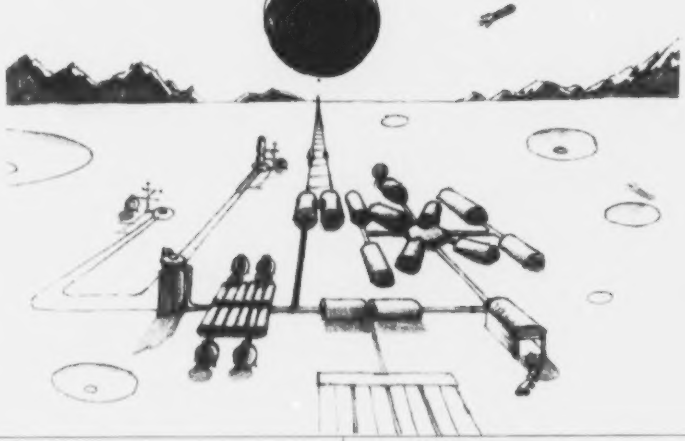
With the development of reusable launch vehicles and satellites that can transmit solar power via microwaves, many colonies can be constructed. Some colonies will send long-range rovers to look for water ice at the lunar poles, where no sunlight falls. Some will examine the geology of their world, preserved over eons. Some will build radio telescopes on the radio-free Far Side and will search for E.T.s, undisturbed by music stations from Earth.

But most colonies will have factories, using the mineral wealth to plan expeditions to Mars and large free-floating space colonies. Millions of people will have careers on the Moon by the year 2100. Soon children will be born there; they will gaze at the great blue ball on the horizon and wonder that their ancestors ever called *that* home. ✷



KEY

1. Command dome
2. Habitat modules
3. Agriculture modules
4. Communications "tower"
5. Rover garage
6. Photovoltaic cells
7. Soil sifter
8. Smelter
9. Construction bays
10. Oxygen tanks
11. Mass driver loading bays
12. Vehicle Assembly Building
13. Launchpad (one of two)



Richard Reifsnyder won a trip to U.S. SPACE CAMP by placing first individually in National MATHCOUNTS '95 when he was in 8th grade. Now a 10th grader, Rich is taking Advanced Calculus, hopes to major in aerospace engineering at Princeton, and would like to work eventually in the space program as an astronaut.

SELECTED SCIENCE INTERNSHIPS WITH OPTIONS IN PHYSICS &/OR ASTRONOMY

Brandeis Summer Odyssey Science Research Internships (8 weeks)
Rabb School, Brandeis University, P.O. Box 9110, MS 804, Waltham, MA 02254; (617) 736-2111.
Application deadline: April 1, May 15

Early Experience Program: The Making of an **Engineer** (3 weeks)
Pamela Campbell, Center for Educational Services, University of Denver, Wesley Hall #211, Denver, CO 80208; (303) 871-2663
Application deadline: April 30, 1997

High School Honors Science Program: Research Internship (7 weeks)
Dr. Gail Richmond, Michigan State University, 330 Erickson Hall, East Lansing, MI 48824-1034; (517) 355-1725.
Application deadline: April 1

Research in Science at Erskine (RISE): Scientific **Application of Technology** (3 weeks)
Dr. William Junkin III, Dept. of Chemistry & Physics, Erskine College, Due West, SC 29639; (864) 379-8822.
Application deadline: May 15

Research Science Institute (RSI) (6 weeks, in **collaboration with MIT)**
Center for Excellence in Education, 7710 Old Springhouse Road, McLean, VA 22102; (703) 448-9062.
Application deadline: February 1

Secondary Student Training Program (SSTP), **Research Participation Program** (6 weeks)
Iowa Secondary Student Training Office, 323D Chemistry Building, University of Iowa, Iowa City, IA 52242; (319) 335-0040.
Application deadline: March 15

Summer Opportunities and Research for Space (SOARS) (2 weeks)
Dr. Richard Devon, Director, PA Space Grant Consortium, The Pennsylvania State University, 101 South Frear Laboratory, University Park, PA 16802; (814) 863-7688.
Application deadline: March

Summer Research Program for High School Students (8 weeks)
Dr. Clifford Houston, Multicultural Affairs, University of Texas Medical Branch, Galveston, TX 77555-0133; (409) 772-0135.
Application deadline: April 4

SPENDING A SUMMER IN AEROSPACE ENGINEERING

These two high school students landed summer placements in the aerospace field, where they worked as members of technical teams. Both testify that internships are a great way to explore career options.

Hands-On Work with APL Satellite Systems

by Jonah Berger

What should a high school student expect from a summer internship at a major scientific institution? Busywork? Or maybe an odd project that someone else doesn't want to deal with?

My experience at The Johns Hopkins University Applied Physics Lab (APL) last summer was anything but boring. I was integrated into the lab and given a desk, a computer with an Internet address, and even my own phone number. The issues I dealt with were important not only to me but also to the efficiency of an APL satellite orbiting Earth. I was working with amazing people who had helped design this satellite and now were analyzing its performance. It felt good to be doing something worthwhile *and* enjoyable.

Monitoring a Satellite

My job was to help perform data analysis on transmissions to Earth from the Midcourse Space Experiment satellite (MSX), used to track ballistic missiles in their midcourse flight phase. The main purpose of MSX is to recognize the difference between actual missiles and harmless space debris or decoys. It also monitors the contamination of its own optical instruments and gathers data on the Earth's atmosphere.

I worked at the Performance Assessment Center, where spacecraft data are stored. PAC engineers review these data to monitor the efficiency of the satellite's systems and to identify and solve problems that arise. The engineers I worked with deal mainly with "housekeeping" data—how the satellite itself is performing, e.g., the power consumption of each sensor, temperature of the tape heads on the tape recorders, and attitude of the satellite (directions in which the axes are pointing).

Troubleshooting by Computer

One of many projects I tackled involved the MSX's on-board tape recorders. Two tape reels record data, which are then reproduced by transmission back to APL's satellite dishes. The tapes record housekeeping data at specified intervals and sensor events whenever they occur. While one tape is in *reproduce* mode, the other is in *record*, so one of the tapes is recording data at all times.

Continued on page 11, column 1

Experiencing Real-Life Engineering

by Amelia Dudley

Through the National Space Club Scholars Program, I had the opportunity to intern last summer at Goddard Space Flight Center in Greenbelt, Maryland. For six weeks, I enjoyed the privilege of working with scientists and engineers involved with the Tropical Rainfall Measuring Mission (TRMM). A joint project between NASA and Japan's National Space Development Agency, TRMM is one of the satellites being used to study Earth's environment from space in NASA's long-term Mission to Planet Earth.

The TRMM satellite will carry five instruments to gather scientific data, as well as numerous subsystems to provide power, data storage, and data relay for those instruments. My work involved the engineering and design aspects of this project. During my internship, the TRMM spacecraft was in the Integration and Test stage. All the components had been tested individually; now it was necessary to make sure that the systems and instruments worked properly together.

Analyzing Test Data

One of my first tasks was to assist the Power System engineers in analyzing data from a mission simulation test. I first imported the data into an Excel spreadsheet, then reformatted some of the data. Next I created several different graphs (e.g., total power in batteries versus time) that helped the engineers compare the satellite's power consumption with the activities of its other systems during the tests.

I also helped test the Attitude Control System (ACS), which enables the spacecraft to maintain the proper orientation to Earth so that the instruments can collect data. (Without attitude control, the sensors would collect data on outer space, not Earth.) The ACS consists of Sun and Earth sensors, as well as star trackers that determine the spacecraft's position relative to guide stars. I assisted with a test of the Earth sensors: these measure the light reflected by Earth and determine the satellite's attitude by comparing the amount of reflected light hitting each of the sensors' four units.

Continued on page 11, column 2

J. Berger, continued from page 10

But even the normal operation of a tape recorder can cause problems in a low-gravity environment. If the tape recorder were to stop abruptly while in *record* mode, this motion would create enough angular momentum to throw the satellite out of orbit. So the tape must be slowed before and after each mode, then rewound or forwarded to preserve all information.

To compound the problem, the satellite can transmit only while orbiting over APL, so only limited chunks of data are transmitted on each pass. Because only parts of the sensor events are transmitted during a pass, the engineers must know exactly how much tape is left at all times, so that they may reconstruct the event. For this purpose, an accurate equation for time versus tape count (length of tape) must be computed. That's where I came in.

Because the tape count never runs a complete cycle from empty to full, I had to piece together parts of both *reproduce* and *record* functions to make an entire cycle of each mode. To do so, I grabbed information off APL data files, removed all extraneous or false data, and set the values up in a graphing program. Then I created graphs of a full *record* cycle and a full *reproduce* cycle and fit a 6th-order polynomial equation to the graphs. The result was an approximate equation detailing where the tape count should be at any time in a *record* or *reproduce* cycle. Finally, I sent the equation and my findings to all the project engineers. Since this equation better fits the actual data than the original equation did, it will be used in future calculations.

Working at APL was an interesting and exciting experience that gave me insight into future career options. I was amazed at the planning it takes to design satellite systems and at the great attention to detail displayed by the engineers. There's no better way to learn something than to work alongside the people who do it every day. ✸

As a finalist for the APL sponsored Kershner Memorial Scholarship to CTY's summer program, ***Jonah Berger*** *received a tour of APL and arranged this internship through his meeting with a Lab representative. Now an 11th grader at Montgomery Blair High School's magnet program, Jonah is also a varsity wrestler and cross-country runner.*

A. Dudley, continued from page 10

Redesigning to Solve Problems

The other major aspect of design engineering is problem solving: what to do when something designed and built for a specific purpose doesn't work as planned. I found this the most interesting part of my internship, as I took part in many meetings where we discussed the pros and cons of design changes to correct problems discovered during testing.

One problem involved a major instrument, the TRMM Microwave Imager (TMI). TMI was operating at temperatures colder than had been predicted by the engineering model, a simplified but working model of the instrument used to calculate the actual instrument's expected performance. The engineers were worried that TMI, once in space, would become too cold to operate properly. So they were looking for ways to warm it up.

No new equipment could be added to the spacecraft at that late stage, so the challenge was to solve the problem using only what was already slated to be on board. The engineering team brainstormed ways to make use of TMI's emergency heater—already part of the spacecraft—by leaving it on all the time without impacting the emergency procedures for TRMM. After many discussions of options, the team eventually found and implemented a solution that addressed most of the major concerns.

Thanks to my internship at Goddard, I am now more certain than ever that I want to pursue engineering as a career. I enjoy the process of design engineering, but I plan to go back to Goddard next summer for a look at another aspect of the engineering field. ✸

Twelfth grader ***Amelia Dudley*** *attends Thomas S. Wootton High School in Potomac, Maryland. She hopes to work in the aerospace industry while continuing her involvement with theatre.*

The National Space Club Scholars Program is a six-week commuter internship only at Goddard in Greenbelt and Wallops Island, Maryland. Steve Korpon, P.O. Box 563, Crownsville, MD 21032.

BOOK REVIEW

Driving Force: The Natural Magic of Magnets

by James D. Livingston

Are you attracted to the age-old mystery of magnetic materials? Have you ever puzzled over the complex, sometimes counter-intuitive science of magnetism? Are you aware of the range of human activities that depend on the performance of magnets? James Livingston, a lecturer at MIT, engagingly answers your questions about magnets—as well as many you've never thought of—in *Driving Force*, recently published by Harvard University Press.

DRIVING FORCE
THE NATURAL MAGIC OF MAGNETS
JAMES D. LIVINGSTON

Ancient Egyptians thought that compass magnets were magical. Most of us in the late twentieth century are not amazed by refrigerator magnets, but do find the workings of supercolliders, magnetic resonance imagers, and even computers utterly mysterious. Livingston lucidly describes the magnetic underpinnings of these and other human inventions.

In addition to exploring magnetic technology, the author provides an exciting view of magnetism in nature. Livingston looks at the magnetic properties of stones and of the entire Earth, the atmosphere, and stars. He also explores the biological world, finding powerful magnetic influences in the navigation of bacteria, the migration of birds and bees, and the operation of the brain.

I most enjoyed Livingston's discussions of technology, which are greatly enriched by anecdotes from his long tenure at General Electric's research labs. While his stories are entertaining, they also reflect the highly informed perspective of a scientist who has contributed to and continues to advance applications of the driving force of magnetism. ✸

—Robert B. Pond, Jr., Ph.D.

Dr. Pond is a metallurgical engineer and president of M Structures, Inc. He also lectures at The Johns Hopkins University in the Materials Science and Engineering Department.

EXPLORING CAREER OPTIONS: PLANETARY SCIENCE

by Carol Blackburn

Interview with JoBea Way

*Some people who initially get turned on to space exploration end up discovering that Earth itself is a pretty interesting planet. **JoBea Way, Ph.D.**, is one such person. A planetary scientist, she's a member of NASA's Mission to Planet Earth.*

*Her story highlights the interactive relationship between the development of new technology and the course of scientific discovery. She shares with us the excitement of what it's like to be among the first scientists to use a new tool—before anyone **really** knows what it can do.*

Most of us are probably not too clear on what planetary science is. What do you do?

I'm part of a network of scientists all over the world studying the carbon cycle in Earth's atmosphere: how much carbon is in the atmosphere, where it comes from, and whether the levels are changing. Atmospheric carbon (in the form of carbon dioxide, CO_2) is essential in order for life to exist on Earth, but changes in its concentration may be affecting global weather and temperature patterns—a scenario referred to as *global warming*.

Planetary scientists study these sorts of vast and dynamic systems that control planetary heat, atmosphere, and element fluxes. On Earth, these systems work together to make this a liveable planet. Other planets also have such systems—Venus's dense clouds, Jupiter's storms. Learning about the patterns on our own planet helps us understand those that may exist on others.

What drew you to this field?

Like many people who work at NASA, I got hooked on space when Apollo 11 landed on the moon. It was an incredibly exciting time. Being young and impressionable, I wanted to be a part of it. I dreamed of being an astronaut. Throughout high school, my desire to work in the space program drove me to continue taking math and science.

As a 12th grader, I participated in a Student Space Biology Program at NASA Ames Research Center. I got to work with a scientist who was studying life at extreme temperatures, trying to see if any Earth life forms could survive the diurnal temperature variations on Mars. The best thing about that experience was that it opened the doors to NASA for me and gave me connections for the future. It also gave me the confidence to continue to pursue my interests.

JoBea Way during field work in Alaska.

In college, I again wanted to work with someone doing something related to NASA. I found Tom Jukes, who was studying the decontamination procedure that had been used for the Viking spacecraft, looking at whether anything could have survived it and been carried from Earth to Mars. (We concluded that Viking probably *had* carried biological materials to Mars!) He was as excited about the space program as I was and very helpful in advising me about my future.

As a graduate student at Caltech, I worked at the Jet Propulsion Laboratory (JPL), analyzing data from the Pioneer mission to Venus. Once again, I made great connections, including Charles Elachi, the associate director of the laboratory where I now work.

At that time, Elachi was starting JPL's imaging radar program. The second space shuttle flight was to carry the first *shuttle-borne imaging radar* (SIR). It sounded interesting, and as soon as I finished my Ph.D., I joined the SIR program. That's when I got sidetracked to studying Earth.

What is imaging radar?

Imaging radar works like a flash camera, providing its own "illumination" of an area of interest for a snapshot picture. A flash camera sends out a pulse of light, then records on film the light that is reflected back through the camera lens. Similarly, radar sends out a pulse, and the energy reflected back is recorded as a radar image. However, unlike a flash camera, which uses visible light, radar illuminates its subject with microwave (one centimeter to one meter wave length) radiation.

Imaging radar provides a unique way of looking at Earth and other planetary bodies because it can "see" at night and through thick cloud cover. It's been successfully used to image Earth and Venus and will be used to study Saturn's moon Titan, another cloudy body in our solar system.

You got into this work because of an interest in space, but you became more intrigued by what could be learned about Earth from space?

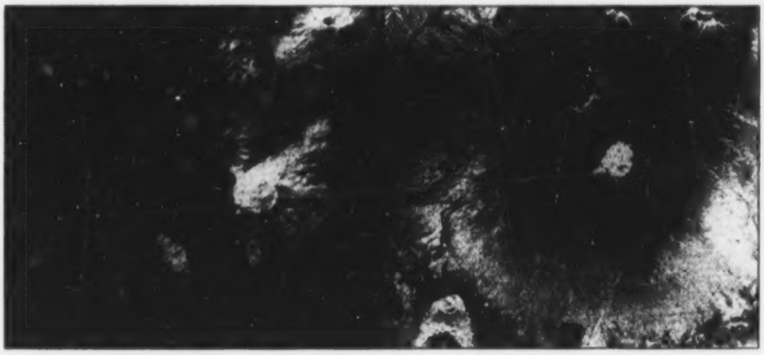
Yes. I was very curious about what you could see from the shuttle. To be able to look out the window and see global patterns go by, patterns that repeat themselves on a huge scale—it must be amazing. I would have *loved* to fly a shuttle mission, but that wasn't in the cards.

SIR gave us a terrific new tool, a new window on Earth. No one had looked at Earth with this kind of radar before, so everything we saw was new. After the first mission, I examined SIR data from an area in southern Argentina and saw some striking differences in image intensity between areas with different kinds of vegetation. That piqued my interest to study those differences further. I spent several weeks tromping around forests in Argentina. It turned out that SIR was excellent for mapping forest type.

Why was that important?

Well, at first we weren't sure; we just knew we could use SIR in that way. While in Argentina, I developed collaborations with other investigators studying forests, and we formed a sort of team to consider how we could work together to better study the forests and ground covers of the world.

To understand what the radar images were showing us about differences in vegetation, we decided to go to Alaska, a region with a less complex flora than Argentina's. We arrived in the midst of a warm spell in March, and everything had started to thaw. We took some radar images from an airplane; then, when everything froze up again a few days later, we took more images. We were very surprised to see *huge* differences in images taken just five days apart. We hadn't expected that at all.



Images courtesy of Jet Propulsion Laboratory

Optical (l) and SIR (r) photographs of Kliuchevshoi volcano in Kamchatka, Russia. The volcano began to erupt on September 30, 1994, during space shuttle mission STS-68. Shuttle astronauts took the optical photo during the early hours of the eruption; the ash plume hides much of the ground. The SIR image was taken five days later; radar penetrated the remaining ash cloud, producing a sharp image of the ground.

What exactly was the imaging radar "seeing"?

Radar is sensitive to two properties of an object or surface: 1) its "roughness" on the scale of a wavelength, which would be, for example, leaves versus no leaves; and 2) its dielectric constant, which is a measure of the degree to which polar molecules within it rotate at the radar wave frequency.

Whoa! Let's take this slowly.

Basically, the frozen and thawed conditions gave us very different image intensities. But now we had to figure out what those differences meant. Were we detecting differences in roughness? Or did frozen and thawed vegetation have different dielectric constants? We concluded that the water in plants constitutes a large quantity of polar molecules that can rotate in response to a radar signal. When those molecules are fluid—in the thawed state—they can rotate freely, and the radar sees them as present. When the tree freezes, the water molecules freeze and can no longer rotate, and the radar sees through them. So we saw dramatic changes in the brightness of the image depending on whether the trees were thawed or frozen.

We were now able to measure frozen or thawed water in vegetation, but we needed to find out whether that was important in understanding anything about the trees' metabolic processes. So we participated in a huge experiment in Canada with many other researchers and found that forests start respiring—thus *releasing* CO_2 to the atmosphere—as soon as they begin to thaw. That's well before the trees begin to photosynthesize and *take in* CO_2.

The net carbon flux in the boreal forest is thus different from what anyone had expected; a rather large amount of CO_2—relative to what had been expected—is released by these forests in the spring. That was quite a finding, and the really exciting thing for us was that the thawing we detected with radar (in this case, a European satellite's imaging radar) correlated with the beginning of the forest's increase in respiration. We could use radar to more accurately assess seasonal carbon flux in the polar regions.

It must be exciting to discover that a technology can do something quite unanticipated like that.

An even more extraordinary discovery was made with SIR data. After our first mission, a U.S. Geological Survey research group was looking at SIR images of the Sahara Desert. They also had some Landsat satellite images, and the two weren't matching up. They kept asking us, "Are you sure you sent us the right data?"

SIR had produced images of what looked like river beds in a sand-covered part of the world. The geologists finally realized that the radar was seeing *through* the sand, detecting materials a few meters *beneath* the desert surface. When they told us that, our jaws just dropped. The whole room went silent because it was such an amazing discovery. They subsequently went to the Sahara, dug, and uncovered rounded pebbles, indicating old stream beds. There had indeed once been rivers there. That's the most amazing discovery anyone in the imaging radar community has made.

Wow! That was a** really **unexpected application.

Completely unexpected. Of course, once word of it got out, we received all sorts of requests from archaeologists, asking us to collect radar images on the next shuttle flight of areas where ruins had been expected but not yet discovered. One such request was for a region in Oman. Through a complex analysis of SIR and Landsat images, scientists were able to locate ancient roads converging. Archaeologists went to the site, dug, and—sure enough—found the Lost City of Ubar.

That must have been thrilling.

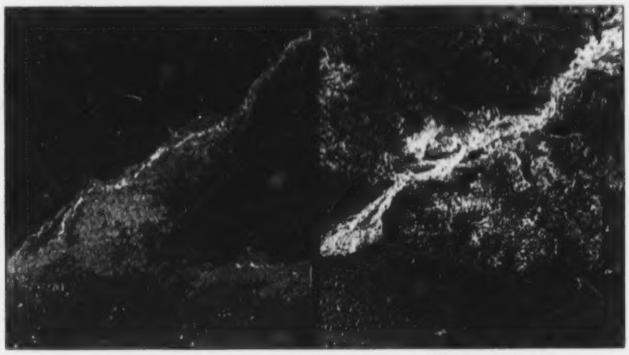
To see a true discovery made in a project in which you are either directly or indirectly involved is indescribably satisfying. These unexpected discoveries—the freeze/thaw effect, the buried rivers—have been among the high points of my professional life.

Of course, such things don't happen every day. A middle school teacher once asked me, "What are the top ten things you've discovered?" And I said, "Ten! I'm glad I've got one!" You don't actually discover many things in a career. You make progress—you can make a lot of progress—but that's a different thing. And it can take a long time to determine whether a discovery is actually useful in any way.

continued on next page

I hate to tear us away from discoveries and lost cities, but where is your work going next?

NASA plans to put an imaging radar on a free-flying satellite and have it up there all the time, sending data down. If we could monitor freeze/thaw patterns in the circumpolar boreal region for ten years, we could contribute to addressing the question of how much carbon is generated and/or taken up by the polar regions. That would be a pretty spectacular result. If we could answer some of these global-change questions—and I think we can—it would be a great accomplishment for the radar program.



Images courtesy of Jet Propulsion Laboratory

Landsat (l) and SIR (r) photographs of a desert area in Oman. SIR's capacity to penetrate thin sand cover reveals underlying geological features not visible in the optical image.

You're analyzing carbon flux in the polar regions; others are studying carbon flux elsewhere on the planet. Is anyone piecing together this kind of data from all over the world?

One man at NASA headquarters, Dixon Butler, had a powerful vision that NASA needed to be a part of solving some of Earth's big problems. He brought together study groups of scientists to identify the questions that most needed to be resolved about Earth's systems. We agreed that global warming is a big one.

NASA's Mission to Planet Earth (MTPE) now has interdisciplinary teams focused on various global systems like the carbon cycle. Global-systems models fed by satellite data are still in their early days. It's a long road from a radar image—just one small piece of data—to an accurate calculation of a global carbon flux. Clearly, one of MTPE's challenges is to refine computer models of global systems, make them really work and give valid predictions. And for that, we need more data.

In 1998, NASA will launch the first of a series of remote-sensing satellites to gather data for long-term studies of Earth systems. The MTPE teams are making sure we create a remote-sensing system that will collect the kinds of data needed to answer our big questions. However, many of those questions can't be answered until we collect five to ten years of data; because any given year could be an anomalous one, we need multiple-year readings in order to draw meaningful conclusions.

What do you see happening in planetary science five to ten years from now, when some of our readers may be in graduate school?

By then, we'll have several years' worth of Earth-monitoring satellite data, so researchers will really be in a position to validate or disprove different models and to determine whether and why the planet is warming up or cooling down. And the power of computers ten years hence should allow people to run such models on desktop PCs.

And who knows? One of your readers may be the one to make the next discovery similar to seeing buried rivers where no one else saw them. I know there are many more discoveries to be made in this data. There's so much of it—you could spend a lifetime looking at it. ✷

Selected Resources

Evans, D.L., Stofan, E.R., Jones, T.J., & Godwin, L.M. (December 1994). Earth from sky. *Scientific American, 271*, 70-75.

NASA and JPL websites

NASA's Mission to Planet Earth home page
http://www.hq.nasa.gov/office/pao/NASA/mtpe.html

JPL Imaging Radar home page
http://southport.jpl.nasa.gov:80/index.html

Imaging Radar Images of Earth
http://www.jpl.nasa.gov/sircxsar/

"What is Imaging Radar?" tutorial
http://southport.jpl.nasa.gov/desc/imagingradarv3.html

Selected Astronomy & Physics Web Sites

Astronomy

NASA News
http://www.hq.nasa.gov/office/pao/NewsRoom/today.html

Astronomy Picture of the Day
http://antwrp.gsfc.nasa.gov/apod/astropix.html

Listings of many astronomy links
http://bang.lanl.gov/solarsys/net.htm
http://antwrp.gsfc.nasa.gov/apod/lib/edlinks.html

High Energy Astrophysics Learning Center
http://heasarc.gsfc.nasa.gov/docs/learning_center/

Center for Mars Exploration
http://cmex-www.arc.nasa.gov/

The Nine Planets: A Multimedia Tour
http://seds.lpl.arizona.edu/nineplanets/nineplanets

The Planets (CD-ROM by *Scientific American*)
http://www.byronpreiss.com/digiba/planets/

Dance of the Planets ("serious, number-crunching" CD-ROM)
http://www.arcinc.com/arcindex.htm

Physics

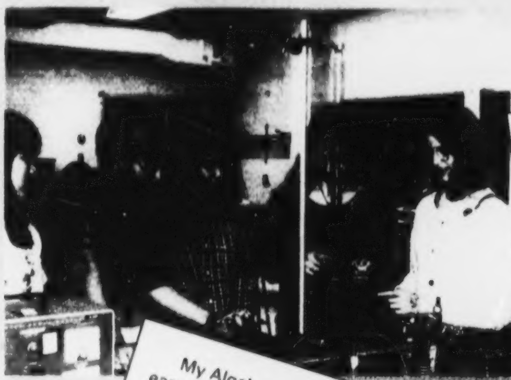
Physics News
http://www.het.brown.edu/news/index.html

Physics Internet Resources
http://www.het.brown.edu/physics/index.html

WWW Virtual Library—Physics
http://www.w3.org/vl/Physics/Overview.html

The Ultimate Einstein (CD-ROM)
http://www.byronpreiss.com/digiba/einstein/

For a more extensive list, see *Imagine*'s links for this issue:
http://jhunix.hcf.jhu.edu/~setmentr/links_43.htm



ZEROING IN ON ACADEMIC SUMMER PROGRAMS

Where You Can Stretch Your Mind and Have Fun

***Fan Mail:** Several students who took intensive courses at IAAY summer sites reminisce about their experiences. Programs like those listed on the next two pages offer stimulating academic challenges and supportive peer communities.*

My Algebra II class seemed pretty easy at first because it was mainly review from Algebra I. Then I failed the Chapter 2 test. To most people this would have been a disaster, but for me it was a blessing in disguise. It helped me realize that I really had to strive to get As. In regular classes I do not really have to try, and I still pass with flying colors. But in this class I had to work for everything. That was the boost I needed.

The residential life was great: I always had someone to talk to, laugh with, and eat meals with. I keep in touch with some of the friends I made there; I will never forget them.

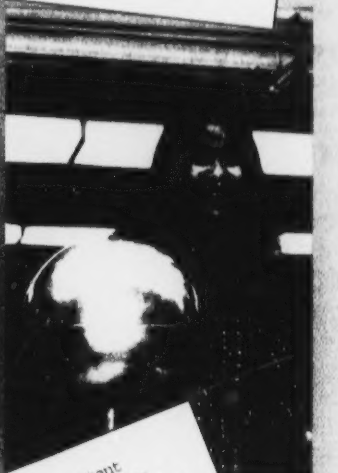
Jeff Bishop
New Brighton, PA

From the moment that my family and I arrived on campus, we felt welcome, and I knew it was going to be a fantastic three weeks.

In Latin I, I felt truly challenged, something I had never really experienced in any class before. By the end of the first day, we had completed three chapters and were already starting to translate passages. By the end of three weeks I'd gained a fairly large Latin vocabulary and was able to read and understand some Latin, as well as do some translating from English into Latin. We learned about Roman and Greek culture, read a play by Plautus, saw *A Funny Thing Happened on the Way to the Forum*, and analyzed speeches against the Roman politician and conspirator Catiline.

But there was much more to this program than studying. In just three weeks, I learned how to juggle, sharpened my improvisational acting and tennis techniques, learned the art of spaghetti engineering, caught up on karate, cooled off in the Olympic-sized pool, did some track running, and even had free time to go for a shake in the campus store. On the weekends, there were dances and carnivals and luaus and crafts and movies and almost everything imaginable. IAAY provided an experience I'll never forget!

Angela Kusaj, Emporia, VA



Before I went to CTY, I felt emotionally isolated. To me, my talents seemed like curses because they set me apart when I felt as though I needed to fit in. Meeting so many other talented people changed all that. I gained a new sense of being part of a community of gifted students, and I formed lasting friendships.

Annette Tardiff
Marlborough, NH

I learned many important skills in my "Writing and the Printed Word" class. We worked on writing cliché-free poetry, practiced the art of revision and brainstorming, and learned to use living adjectives and verbs for inanimate objects. We also learned how to make our own books: folding paper, gluing properly, working with sharp tools such as the awl and X-ACTO knife, sewing and binding, and setting type and working a printing press.

This was my first experience away from home; the great friends I made, along with a terrific RA, made it a super one.

Megan Portanova
New Canaan, CT

Of all the CTY courses I have taken, Number Theory was by far the best. My instructors were outstanding. I learned a great deal of math, from the Peano Axioms to Fermat's Last Theorem, and had a lot of fun doing it. Class was never dull as we were presented with something new and challenging every day. Of all that I learned in the three weeks, writing effective formal proofs was probably the most important, because during the school year I participate in numerous math competitions, many of which require me to write extensive proofs in a short amount of time. In Number Theory, we learned not only the three basic types of proofs—Direct, Indirect, and Mathematical Induction—but also special proof techniques like "Shrinkification."

James Chen, Flushing, NY

Photos by Ellen Banasik, laboratory assistant in the IAAY/CTY Physics class at Franklin & Marshall College, summer '96.

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SELECTED ACADEMIC SUMMER PROGRAMS

Many opportunities exist for you to continue to challenge yourself academically during the summer. We have received positive reports from participants about the programs listed below.

Unless otherwise noted, applications are due in April and May. *Space in many summer programs is limited, so we suggest you apply early. You'll want to inquire about qualification requirements, course options, dates, fees, and scholarship availability. Grades specified refer to students'* ***current*** *grade level.*

IAAY ACADEMIC SUMMER PROGRAMS

CENTER FOR ACADEMIC ADVANCEMENT
Grades 7 & 8, 3 weeks, residential sites in CA, MD, and PA.

CENTER FOR TALENTED YOUTH
Grades 7–10, 3 weeks, residential and commuter sites in CA, MD, NY, and PA.

CTY YOUNG STUDENTS
Grades 2–6, 3 weeks, commuter sites in MD and VA. Grades 5 & 6, 3 weeks, residential sites in CA, CT, and MD.
IAAY Summer Programs, The Johns Hopkins University, Baltimore, MD 21218; (410) 516-0277 or (818) 500-9034.

SDB LEARNING CENTER
Grades 4–6, 4 weeks, commuter site in CA.
SDB Learning Center, IAAY, The Johns Hopkins University, 206 N. Jackson Street, Suite 304, Glendale, CA 91206; (818) 500-9034.

OTHER REGIONAL TALENT SEARCH PROGRAMS

CENTER FOR TALENT DEVELOPMENT
Grades 5–12, 3 weeks, residential and commuter.
CTD, Northwestern University, 617 Dartmouth Place, Evanston, IL 60208; (847) 491-3782.

DUKE UNIVERSITY TALENT IDENTIFICATION PROGRAM
(See also Science and Study Abroad.)
Grades 7–10, 3 weeks, residential.
Duke University TIP, Box 90747, Durham, NC 27708-0747; (919) 684-3847.

ROCKY MOUNTAIN SUMMER INSTITUTE
Ages 10–15, 2 weeks, commuter. Ages 12-16, 3 weeks, residential and commuter.
Rocky Mountain Talent Search, University of Denver, Wesley Hall-Room 203, 2135 East Wesley Avenue, Denver, CO 80208; (303) 871-2983.

OTHER TALENT SEARCH-TYPE PROGRAMS

ADVANCE PROGRAM FOR YOUNG SCHOLARS
Grades 7–11, 3 weeks, residential.
Programs for the Gifted and Talented, Northwestern State University, P.O. Box 5671, Natchitoches, LA 71497; (800) 259-4438 (within state); (318) 357-4500.

ACADEMIC TALENT SEARCH AND ACCELERATED COLLEGE ENTRANCE CENTER
Grades 6–9, 3-6 weeks, commuter.
ATS, California State University-Sacramento, 6000 J Street, Sacramento, CA 95819-6098; (916) 278-7032.

BELIN-BLANK CENTER
Grades 6–8, Junior Scholars Academy; grades 9–11, National Scholars Academy, and Summer Institute for Creative Engineering and Inventiveness. One week, residential.
Belin-Blank International Center for Gifted Education and Talent Development, The University of Iowa, 210 Lindquist Center, Iowa City, IA 52242; (319) 335-6148 or (800) 336-6463.

CENTER FOR ACADEMIC PRECOCITY
Grades preK–11, 5 weeks, commuter. Grades 5–6, 3 weeks, residential. Grades 7–11, 5 weeks, residential.
CAP, Arizona State University, Box 872711, Tempe, AZ 85287-2711; (602) 965-4757.

CENTER FOR GIFTED STUDIES
Grades 7–10, 3 weeks, residential.
The Center for Gifted Studies, University of Southern Mississippi, Box 8207, Hattiesburg, MS 39406-8207; (601) 266-5236.

OFFICE OF PRECOLLEGIATE PROGRAMS FOR TALENTED AND GIFTED
Grades 7–9, Explorations, 1 week. Grades 7–10, CY-TAG, 3 weeks. Grades 10–11, Iowa Scholars Academy, 4–8 weeks. Residential and commuter.
OPPTAG, W172 Lagomarcino Hall, Iowa State University, Ames, IA 50011-3180; (515) 294-1772.

PURDUE UNIVERSITY GIFTED EDUCATION RESOURCE INSTITUTE
Grades 6–8, Star; grades 9–12, Pulsar; Nova college credit; 2 weeks.
Summer Residential Programs, Purdue University GERI, 1446 LAEB, Room 5114, West Lafayette, IN 47907-1446; (317) 494-7243.

SOUTHERN METHODIST UNIVERSITY GIFTED INSTITUTE AND PRECOLLEGE PROGRAMS*
Grades 7–9, 3 weeks. Grades 10–11, 5 weeks. Residential and commuter.
SMU/TAG, P.O. Box 750383, Dallas, TX 75275-0383; (214) 768-5437.

SUMMER PROGRAM FOR VERBALLY AND MATHEMATICALLY PRECOCIOUS YOUTH*
Grades 7–10, 3 weeks, residential.
VAMPY, The Center for Gifted Studies, Western Kentucky University, One Big Red Way, Bowling Green, KY 42101-3576; (502) 745-6323.

SUMMER STRETCH*
Grades 7–9, 5 weeks, commuter.
Halbert Robinson Center for the Study of Capable Youth, University of Washington, Box 351630, Seattle, WA 98195-1630; (206) 543-4160.

WISCONSIN CENTER FOR ACADEMICALLY TALENTED YOUTH
Grades 7–12, 3 weeks, residential.
WCATY, 2909 Landmark Place, Madison, WI 53713; (608) 271-1617.

* *First come, first served.*

HUMANITIES

CONCORDIA LANGUAGE VILLAGES
Ages 7–18, 1–4 weeks, residential.
Concordia Language Villages, 901 South Eighth Street, Moorhead, MN 56562; (218) 299-4544, (800) 247-1044 (within state) or (800) 222-4750 (out of state).

Foreign Language Institute, and Writing & Thinking Workshop

Grades 9–12, college credit, residential.
Foreign Language Institute, Simon's Rock College of Bard, 84 Alford Road, Great Barrington, MA 01230-9702; (413) 528-7227.

Junior Statesmen Summer School

Grades 9–11, 3–4 weeks, multiple residential sites in U.S.
The Junior Statesmen Foundation, 60 East Third Avenue, Suite 320, San Mateo, CA 94401; (800) 334-5353.

Summer Institute for the Gifted

Grades 4–11, 3 weeks, multiple residential sites.
Summer Institute for the Gifted, College Gifted Programs, 120 Littleton Road, Suite 201, Parsippany, NJ 07054-1803; (201) 334-6991.

MATHEMATICS

Hampshire College Summer Studies in Mathematics

Grades 9–11, 6 weeks, residential.
Rolling admissions.
HCSSIM, Hampshire College, Box NS Amherst, MA 01002; (413) 582-5375.

Program in Mathematics for Young Scientists

Grades 9–11, 6 weeks, residential.
Applications accepted March 1-June 1.
PROMYS, Department of Mathematics, Boston University, 111 Cummington Street, Boston, MA 02215; (617) 353-2563.

Rose-Hulman Young Scholars Program**

Grades 8–11, 3 weeks, residential.
Dr. George Berzsenyi, Rose-Hulman YSP, Department of Mathematics, Box 130, Rose-Hulman Institute of Technology, Terre Haute, IN 47803; (812) 877-8474.

Ross Young Scholars Program**

Ages 14–17, 8 weeks, residential.
Ross YSP, The Ohio State University, 100 Mathematics Building, 231 W. 18th Avenue, Columbus, OH 43210; (614) 292-5331.

***NSF-sponsored programs. To learn about other subsidized science and math Young Scholars Programs, call the National Science Foundation: (703) 306-1616.*

SCIENCE

Brandeis Summer Odyssey & Odyssey Academy**

Grades 9–11, 4–8 weeks, residential.
Brandeis Summer Odyssey, Rabb School, Mailstop 084, Brandeis University, P.O. Box 9110, Waltham, MA 02254-9110; (617) 736-2111.

Duke University TIP Marine Labs

Grades 8–10, 3 weeks, Piver's Island, NC.
Grades 7–10, 3 weeks, Texas A&M-Galveston, TX. Residential.
Duke University Talent Identification Program, Box 90747, Durham, NC 27708 0747; (919) 684-3847.

Duke TIP Scientific Field Studies

Grades 8–11, 3 weeks, residential sites in Costa Rica, CO, NM, and VA.
Duke University Talent Identification Program, Box 90747, Durham, NC 27708-0747; (919) 684-3847.

STUDY ABROAD

CTYI, Dublin

Ages 12–16, 3 weeks, residential.
The Irish Centre for Talented Youth, Dublin City University, Dublin 9, Ireland; 353-1-7045634; fax 353-1-7045693.

Duke TIP International Summer Study Trips

Grades 8–11, 3 weeks; China, England, France, Germany, Italy, and Japan.
Duke University Talent Identification Program, Box 90747, Durham, NC 27708-0747; (919) 684-3847.

International Summer Science Institute

Grade 12 with independent research experience, 5 weeks, study and travel in Israel.
Deadline: March 1.
International Summer Science Institute, American Committee for the Weizmann Institute of Science, Suite 117, 51 Madison Avenue, New York, NY 10010; (212) 779-2500; fax (212) 779-3209.

Oxbridge Academic Programs

Ages 14–18, 4 weeks, England and France.
Oxbridge Academic Programs, 601 Cathedral Parkway 7R, New York, NY 10025-2186; (800) 828-8349 or (212) 932-3049.

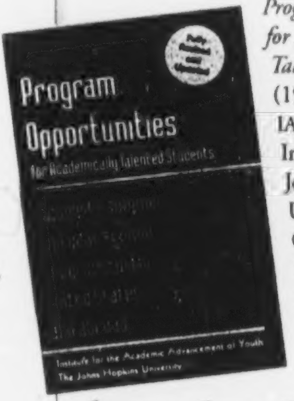
OTHER RESOURCES

Ask about precollege programs at local colleges and universities, and consult these guides:

Advisory List of International Educational Travel and Exchange Programs 1996-97 ($8.50)
Council on Standards for International Educational Travel, 3 Loudoun Street SE, Leesburg, VA 20175; (703) 771-2040.

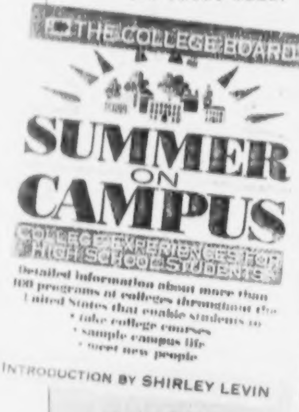
Computerized Database of Summer Programs for Gifted and Talented Students
Sandra Berger, The Council for Exceptional Children, 1920 Association Drive, Reston, VA 22091; (800) CEC-READ.

Educational Opportunity Guide: A Directory of Programs for the Gifted (1996, $15.00)
Duke University Talent Identification Program, P.O. Box 90780, Durham, NC 27708-0780; (919) 683-1400.


Program Opportunities
for Academically Talented Students
Institute for the Academic Advancement of Youth
The Johns Hopkins University

Program Opportunities for Academically Talented Students (1996, $10.00)
IAAY Office of Public Information, The Johns Hopkins University, 3400 N. Charles Street, Baltimore, MD 21218; (410) 516-0245.

Summer on Campus: College Experiences for High School Seniors (1995, $15.00)
Available in bookstores or from College Board Publications, Box 886, New York, NY 10101-0886.


THE COLLEGE BOARD
SUMMER ON CAMPUS
COLLEGE EXPERIENCES FOR HIGH SCHOOL STUDENTS
Detailed information about more than 100 programs at colleges throughout the United States that enable students to
• take college courses
• sample campus life
• meet new people
INTRODUCTION BY SHIRLEY LEVIN

Summer Opportunities for Kids and Teenagers (1996, $26.95)
Available in bookstores or from Peterson's Guides, P.O. Box 2123, Princeton, NJ 08543-2123; (800) 338-3282.

Calendar for College Planning and Preparation

Part II: Grades 10, 11, 12

by Linda E. Brody, Ed.D.

To be fully prepared for college, you must begin planning early: take challenging courses, gain academic skills, participate in activities, and garner the credentials that will appeal to the college of your choice. To identify a college where your needs and abilities will be well matched and where you can look forward to a satisfying four years, you need to engage in self examination and investigate your options fully.

Our timeline is suggested as a guide to help students in grades 10, 11, and 12 manage this process.

Grade 10

You have the luxury this year of exploring colleges without pressure. Take advantage of it.

- Take the PSAT in the fall for practice.
- Get more involved in extracurricular activities that you enjoy.
- Spend time in the guidance office or career center reading college catalogues and investigating other resources.
- Attend a college fair where college representatives display information and talk to prospective applicants.
- Visit college campuses whenever possible. Keep notes on campus attributes that seem positive or negative to you.
- Seek opportunities for career exploration through part-time jobs, volunteer activities, internships, and mentorships.
- Take SAT II Achievement tests and AP exams relevant to your courses this year.
- Reevaluate your curriculum plan with a guidance counselor. If you are running out of challenging coursework, consider part-time college courses during grades 11 and 12.
- Read books, magazines, and newspapers in your free time.
- Plan an interesting, challenging summer. Consider enrolling in a summer course to acquire the background to take more advanced courses during grades 11 and 12.

Grade 11

This is probably your most important year for establishing a strong academic record and proving your commitment to extracurricular efforts.

- Evaluate your courses, study habits, and extracurricular activities to maximize your performance in all areas.
- Take the PSAT in the fall; scores will be used for the National Merit Scholarship Qualifying Test.
- Think seriously about what you want in a college: big or small campus, urban or rural setting, highly competitive or less so, etc. Contemplate your long-term goals.
- Discuss college plans with your parents and guidance counselor.
- Spend time in your school's guidance office or career center reading college catalogues. Use a computerized college search if available. Learn about financial aid options. Develop a list of colleges that appear to meet your needs.
- Meet with college admissions representatives who visit your school; attend a college fair.
- Talk with graduates of your high school about their college experiences.
- Visit as many colleges on your list as possible, preferably during the school year. Call ahead to arrange an admissions interview, tour, and overnight dorm stay.
- Focus on the extracurricular activities you enjoy most. Work to assume a leadership role this year or next.
- Practice for the SATs with old tests, available from The College Board or in bookstores.
- Take the SAT I—and the ACT, if it's required by any colleges on your list.
- Take the SAT II exams required by colleges on your list, especially if you are considering Early Decision. (If you will apply for regular admission, you may take some in the fall or winter of grade 12.)
- Take AP exams for any AP courses you took this year.
- Continue to read books, magazines, and newspapers in your free time.
- Reevaluate your curriculum plan. If appropriate, make arrangements for college courses or other supplemental learning opportunities during grade 12.
- Consider working with a mentor this summer or next year.
- Plan a great summer. Increase your learning beyond high school offerings or develop an area of interest more fully. If appropriate, ask a mentor, teacher, or other adult for a college recommendation based on your summer experiences.
- Over the summer, write to colleges for admissions and financial aid applications.

Grade 12

The pace and intensity of the college process increase significantly this year.

- Continue to work hard to excel in school. Don't succumb to senior slump; colleges may rescind an offer of admission if your grades drop dramatically.
- Show commitment to extracurricular interests through leadership and/or high achievement.

- Retake SAT I if you believe your score will improve. Take remaining SAT II tests.
- Visit additional colleges, if necessary.
- Sign up for college interviews. Send thank-you notes afterwards.
- Meet with college admissions representatives who visit your school.
- Discuss your college preferences with your counselor. Be sure your final list includes at least one college where you are sure to be accepted and where you will be happy.
- Ask for letters of recommendation from your teachers and guidance counselor.
- Mark your calendar with admission deadlines. Prepare all application materials carefully. File your application and all supplementary materials—recommendations, transcripts, standardized test scores, financial aid information—on time.
- Check with college admissions offices to verify that they have received all your application materials.
- Take AP exams for this year's AP courses.
- If you're still undecided about which college to choose when acceptances arrive, plan a visit and stay in the dorm.
- Send thank-you notes to your guidance counselor, teachers, and anyone else who helped you in the admissions process.
- Continue to read books, magazines, and newspapers in your free time. This knowledge base will help you in college—and in life.

References

Berger, S.L. (1989). *College planning for gifted students.* Reston, VA: Council for Exceptional Children.

College bound: A comprehensive guide to optimal preparation & decision making (1994). Baltimore: IAAY Publications & Resources.

If you missed our September/October issue on "Planning Ahead for College," you may order a copy by calling (800) 548-1784.

THE COACH'S CORNER

by Chengde Feng

Mr. Feng teaches mathematics at the Oklahoma School of Science and Mathematics (OSSM) and has coached many students who have competed successfully in mathematics contests in China and the U.S. In this column, Mr. Feng offers Imagine readers questions designed to improve their problem-solving skills.

SOLUTIONS TO THE MATH PROBLEMS FROM THE NOVEMBER/DECEMBER ISSUE

1. For positive numbers a and j, $a^2 > a^2 - j^2 = (a - j)(a + j)$.
Let $a = 18$ and $j = 17, 16, \cdots, 2, 1$.
Then $18^2 > (18 - 17)(18 + 17) = 1 \times 35$, $18^2 > (18 - 16)(18 + 16) = 2 \times 34$, ……, and $18^2 > (18 - 1)(18 + 1) = 17 \times 19$. Multiplying all these inequalities results in $18^{34} > 35 \times 34 \times \cdots \times 19 \times 17 \times 16 \times \cdots \times 2 \times 1$, and thus $18^{35} > 35!$

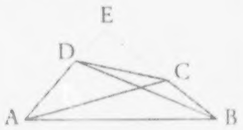
2. Recalling the sum of an arithmetic sequence,
$\frac{1}{2} n(n + 1) = \overline{aaa} = 100a + 10a + a = 3 \times 37a \Rightarrow n(n + 1) = 2 \times 3 \times 37a \Rightarrow$ either $37 \mid n$ or $37 \mid (n + 1)$.

(1) If $37 \mid n \Rightarrow (n + 1) \le 2 \times 3 \times a \le 2 \times 3 \times 9 = 54 \Rightarrow n = 37$. But the equation $37 \times 38 = 2 \times 3 \times 37a$ has no integer solution for a.

(2) If $37 \mid (n + 1) \Rightarrow n \le 54 \Rightarrow n + 1 = 37 \Rightarrow n = 36$.
In this case, $a = 6$ and $\frac{1}{2} \cdot 36 \times (36 + 1) = 666$.

We conclude that $n = 36$.

3. Let E be the intersection of the extensions of $\overline{AD}$ and $\overline{BC}$.
$m\angle DAB + m\angle ABC = 90 \Rightarrow m\angle E = 90$
$\Rightarrow AC^2 = AE^2 + EC^2$ and $BD^2 = BE^2 + ED^2$
$\Rightarrow AC^2 + BD^2 = (AE^2 + BE^2) + (EC^2 + ED^2) =$
$AB^2 + CD^2 = 7^2 + 5^2 = 74$.



4. $f(x) = \sqrt{8x - x^2} - \sqrt{14x - x^2 - 48} = \sqrt{(8x - x)x} - \sqrt{(8x - x)(x - 6)} =$

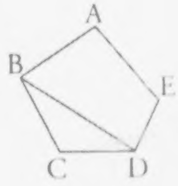
Note that D_f is $6 \le x \le 8$.

$$\sqrt{8 - x}\,(\sqrt{x} - \sqrt{x - 6}) \bullet \frac{\sqrt{x} + \sqrt{x - 6}}{\sqrt{x} + \sqrt{x - 6}} = \frac{6\sqrt{8 - x}}{\sqrt{x} + \sqrt{x - 6}}$$

The maximum value of f(x) occurs at the left endpoint $x = 6$ (why?)
The maximum value of f(x) is $f(6) = \frac{6\sqrt{2}}{\sqrt{6}} = 2\sqrt{3}$

5. The sum of the measures of the five interior angles of the convex pentagon is 540°.
$\Rightarrow$ The measure of the largest interior angle ≥ 108.
Without losing generality, suppose that $m\angle C \ge 108$ and that, by drawing $\overline{BD}$, $m\angle CBD \le m\angle CDB$.
$\Rightarrow m\angle CBD \le \frac{1}{2}(180 - C) < 90 \Rightarrow \sin\angle CBD \le \sin\frac{1}{2}(180 - C)$

Note that $l \ge BD$ and $s \le CD$.



$$\Rightarrow \lambda = \frac{l}{s} \ge \frac{BD}{CD} = \frac{\sin C}{\sin\angle CBD} \ge \frac{\sin C}{\sin\frac{180 - C}{2}} = \frac{\sin C}{\cos\frac{C}{2}} =$$

$2\sin\frac{C}{2} \ge 2\sin 54°$

($\lambda = 2\sin 54°$ if and only if ABCDE is a regular pentagon)

FASCINATING CLASSICS

THE HOUSE OF THE SPIRITS

by Isabel Allende

Review by
Lesley Mackay & Ned Balbo

Lesley: Ned, I am looking forward to our discussion today. Isabel Allende's *House of the Spirits* is one of my favorite books. This work—part family saga, part exploration of human consciousness, and part political allegory—has amazing scope and sweep. Elaborating the lives of several generations of one complex family, Allende illustrates the modern history of Latin America. In so doing, she provides one of the most brilliant interweavings of the personal and the political that I have ever encountered in a novel.

Ned: Yes, Lesley, *The House of the Spirits* is an impressive book, one that succeeds through sheer narrative mastery. Allende embroiders extensive, often humorous, digressions into her plot and also incorporates graceful shifts from comic and tragic moments to dramatic action, to quiet reflection, to ironic commentary. In some extraordinary passages, she is even able to combine all of these.

What impresses me most about the book, though, is its ambitious investigation of human differences. At the heart of the novel, I think, is Allende's exploration of the relationship between the genders and the ways in which this relationship is reflected in the political world. Esteban Trueba, the novel's patriarch, and Clara, his wife, are, for Allende, archetypal male and female figures.

Esteban is a visionary, both noble and corrupt, with a tremendous capacity for hard work and an unshakable sense of purpose. Nonetheless, he abuses the power that he accumulates and frequently behaves irrationally. By contrast, Clara is calm and compassionate. Like other men and women in the novel, these two are sometimes able to bridge the gap between what Allende portrays as their essentially different natures.

Lesley: I agree, Ned, that Allende brilliantly evokes the male and the female and the possibilities of reconciliation between the two. I certainly felt more drawn to Clara, a wild-haired, deeply spiritual woman who is the novel's life force. With strong ties to the supernatural and the maternal, Clara embodies openness and empathy—saving qualities that have the potential to disarm violence and tyranny in both homes and nation states.

Throughout the novel, the family moves back and forth between two residences, houses that highlight the contrasts between Clara's and Esteban's personalities.

The couple's city residence is Clara's principal domain, the ancestral home of her family, and the house of the spirits of the novel's title. This residence is crowded with an eclectic mix of antique furniture, exotic artifacts, dogs and birds, the Truebas' quirky friends and relatives, and ghosts. Clara presides over this mélange in a distracted but effective manner, often managing to neutralize by her very presence her husband's controlling personality.

Esteban's sphere is Tres Marías, the rural hacienda that he governs like a medieval feudal estate. As a young man, Esteban transformed Tres Marías from an unproductive, disorganized ruin into an efficient agrarian empire. He did so in large part by commanding his poor, uneducated tenants to work unceasingly in order to realize and maintain his vision.

By the middle of the novel, Esteban has become a national political figure who personifies the forces that drove the domination of Latin America by elites. Having helped to harness the natural wealth of a continent, Esteban is now a proud member of the ruling class who advocates a tough and even repressive social environment.

Ned: Esteban knows how to protect his own best interests, doesn't he, Lesley? And in some senses, he certainly comes a long way. As a young man, he battled a sense of his own powerlessness by obtaining wealth, first as a miner who literally plumbed the earth for riches and second as a landlord exploiting the fields of Tres Marías. A few years later, with his family and business fully established, Esteban's passion for power and control remains as strong as ever. Yet, despite his ability to dominate others in the political and social arenas, Esteban becomes more and more insecure, increasingly suspecting betrayal at the hands of family members and fellow citizens.

Esteban's personality reflects a classic paradox. Allende shows that her patriarch's egotistical posturings and terrible harshness are fundamentally admissions of weakness. His great drives are compulsive and based in fear.

Lesley: Your explanation makes me realize that Allende does encourage us to understand and even sympathize with Esteban's insecurities. But at the same time she also makes plain the suffering that this character inflicts. Because the author is interested in sketching the historical dynamics that shaped Latin America, a prominent theme in *The House of the Spirits* is exploitation. This theme is developed through the novel's evocation of the relationship of elite men

A Letter that Became a Novel

The House of the Spirits began as a letter from Isabel Allende to her dying grandfather. Allende, about forty at the time, was writing to assure her grandfather that he would never be forgotten; to prove it, she wove into her missive anecdotes he had told her about his youth. The letter took off, expanding into this multi-generational saga. Although the novel's characters were loosely based on Allende's family members, they quickly took on mythical, exaggerated qualities that gave them a life of their own.

One might argue that, as a first-time novelist, Allende was blessed: growing up in Chile, she had been surrounded by a colorful family on a collision course with history. Even her ambitious mixing of the personal and the political grew out of real life. Allende's uncle, Salvador Allende, was the famous socialist president who in 1973 lost his rule and his life to the Chilean military.

Allende provides an account of her experience writing *The House of the Spirits* in her latest book, *Paula*. This work is an autobiographical to the land, to the poor, and to women. All three of these come together in Esteban Trueba's cruel and brutal treatment of the indigenous peasant women who work on his estate and whom he appropriates at will for his own sexual pleasure.

Pancha García is one of these, and through her Trueba begins a family of illegitimate offspring at Tres Marías that will eventually include many mothers. By the time he marries into a family of European ancestry and begins to father legitimate children with Clara, the hidden side of his family tree has branches of which he is willfully oblivious.

Of course, race and class mark the division between Esteban's legitimate and illegitimate descendants. For the most part, they lead separate lives, either unaware that they are related or, in the case of the less privileged relations, indifferent to a bloodline from which they cannot benefit. By sketching this division of the Trueba line, Allende expresses the breach between the native and colonial classes that is still present in Latin America.

Ned: Yet, despite the alienation that you describe, Lesley, the ruling and the ruled do come together in this novel, and not only as adversaries. The genders generally become less polarized as the Trueba dynasty progresses, and the offspring of rich and poor mix more freely. Most prominently, Clara and Esteban's daughter, Blanca, devotes herself to a secret lifelong love affair with a musician and social reformer who was born a tenant at Tres Marías. Pedro is never revealed to be the father of Blanca's daughter, Alba. Despite his granddaughter's ambiguous paternity, the elitist Esteban grows to cherish her above all else, with a love that she returns.

An ongoing, though often temporary, reconciliation of rich and poor takes place not only through the mixing of blood but also through the exchange of ideas and sympathy. While Clara is a profoundly apolitical woman, more at home with supernatural than worldly power, her granddaughter becomes a real political activist. Alba, a college student by the end of the novel, becomes swept up in and committed to revolutionary politics. In so doing, she takes a stand against the vested interests so perfectly represented by her beloved grandfather Esteban.

Lesley: And so the plot thickens right up to the end of the novel. In the haunting conclusion, Alba survives human rights abuses committed by the protectors of the status quo. The final pages portray Alba enduring torture at the hands of the military who have been commanded to destroy the bodies and souls of protestors against the government.

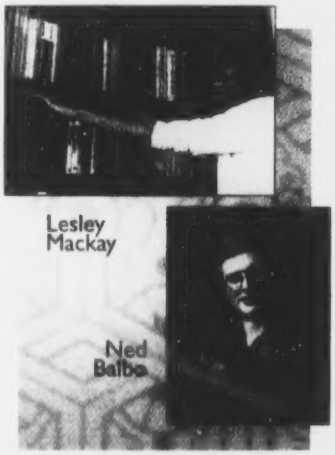
With this heartbreaking turn of events, Allende's novel comes full circle, joining the endpoints of the two Trueba lines. One of the uniformed men in the vicious backlash against the protestors is Esteban García—like Alba, Esteban Trueba's grandchild.

Ned: Esteban Trueba does not know that the young man is his grandson. But Esteban García knows his own identity, and his illegitimacy rankles. In García, now a colonel on the brink of assuming national political power, the destructive effects of Trueba's wayward impulses and infectious rage are distilled in their purest form.

Ironically, Esteban Trueba has sired two grandchildren who have become utter adversaries. Yet, despite his many errors and cruelties, Esteban mellows with age. An old man by the end of the novel, he finally recognizes the extent to which he has damaged his family and participated in the ruin of his country.

Lesley: Alba takes on heroic stature in the novel's final chapters and is revealed as the primary narrator. Clara, we have known all along, has tried to be the family archivist, keeping notebooks recounting family milestones and events. Yet Clara has been oblivious to much of the reality of the Trueba dynasty. It is left to Alba not only to suffer enormously but also to survive in order to weave her grandmother's visionary anecdotes into a larger and much more complex and sobering tale.

Alba's narrative incorporates the luminous beauty of Clara's house of the spirits and the darkest truths of Tres Marías. The final message of her story is that, appearances to the contrary, human beings are all related and must forge a common destiny. ■



Ned Balbo holds advanced degrees in writing from Johns Hopkins and the Iowa Writers' Workshop. He currently teaches in the Writing and Media Department at Loyola College in Maryland. Lesley Mackay is IAAY's staff writer.

memoir integrated into an account of the terrible illness and death of Allende's twenty-eight-year-old daughter. Allende's entire life is interesting, but her account in *Paula* of sitting at a typewriter composing her first novel, after working twelve-hour days as an educator, is moving.

Allende reminds us of the courage, audacity, and simple drive to create that lie at the heart of ambitious writing. And of the confidence it required to send—as she did—a soup-stained, first-time manuscript to a celebrated literary agent.

1996-97 series, Literature from Around the World:

Zora Neale Hurston, *Their Eyes Were Watching God*
Rudyard Kipling, *Kim*
Isabel Allende, *The House of the Spirits*
☛ James Joyce, *Portrait of the Artist as a Young Man*
Alan Paton, *Cry, the Beloved Country*

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STUDENTS REVIEW

UNIVERSITY OF CHICAGO

College Review Series

This on-going series is intended to aid prospective college students in their search by offering insiders' views of selected colleges and universities, as expressed by current undergraduates or recent graduates who have exceptionally high academic ability. Note that the number of reviewers is small. Consider their personal perspectives as only one component while you gather factual information and impressions from such other sources as college catalogues, site visits, talks with officials and students on campus, and the advice of your guidance counselor and teachers.

University of Chicago

Our reviewers include fifteen students, who major(ed) in biochemistry (1), classics (1), computer science (2), East Asian studies (1), economics (1), English literature (1), HPSS (History, Philosophy, & Social Studies of Science) (1), math (3), and physics (4). (U of C does not permit double majors.) Students' comments appear within quotation marks.

Quality of Academic Instruction for Undergraduates

U of C is famous for its extensive, Great Books-based core curriculum. The quality of the education it offers was praised by reviewers as "the best." Reviewers differed in their assessments of faculty accessibility, and several noted that U of C does not practice grade inflation.

"A defining feature of U of C is its extensive core curriculum. Out of 42 trimester courses required for graduation, half must be taken in the core: three courses in the humanities, three in social science, three in civilization, three in biology, three in physical science, two in math, three in language, and one in art or music. Within each category, students have choices from a handful of specific courses. Not all undergrads are happy with the core, but most value it as providing a solid foundation throughout the liberal arts."

"The core curriculum is the big attraction at U of C. One learns from original texts, not textbooks; secondary literature is just not in the picture. The Great Books-based education is delicious, and the use of the Socratic teaching method and small class sizes (15–25) lead to meaningful, text-centered discussions."

"U of C focuses a lot of energy and resources on undergraduates. The vast majority of classes are taught by professors, most of whom not only are renowned in their field but also clearly love what they teach; nothing delights them more than an interest piqued. I've never had a problem talking to professors during office hours."

"I enjoyed most of my classes in the core, especially the Classics of Social and Political Thought and Ancient Mediterranean Civilizations sequences. Furthermore, the core prepared me—a science major—to take upper-level social and political science courses. A disadvantage is that the core takes so much time that students can be limited in the number of courses they take in their major. (Note: This seems to have no adverse effect on acceptance into graduate programs.)"

"Academically, the school is very theoretical, which often makes subjects more challenging. In general, I think the grading is fair and not at all inflated. However, the mean for most premed classes is a C, which is tough."

"My only academic complaints are that (1) despite the extensive selection of courses, it's difficult to find genuinely applied classes in math and science, and (2) the increasingly early specialization that seems to be demanded by graduate schools is discouraged—although I'm not sure this is a bad thing."

"The quality of instruction is good, but I've found accessibility to professors to be limited; most are caught up in their research, although this may be true at most top schools."

"Probably the most difficult adjustment is to the trimester system: not two but three grading periods per school year. Midterms, finals, and term papers are nearly continuous. Our professors cover as much in a 10-week trimester as those at other schools do in a 14- or 15-week semester. This makes for a very intense experience; reflecting upon my time here, I'm in awe of how many books I've read, concepts I've mastered, and new questions I've formulated."

Social Life

The life of the mind plays a central role in the social as well as the academic life at U of C. The serious atmosphere and cold, gray weather do take a toll on the social life, but all reviewers said they made good friends and found plenty to do outside class. They also praised the cultural offerings of downtown Chicago, seven miles away.

"The amount of work and the achievement-oriented mentality of most U of C students put a damper on the social life for some. However, it was easy for me to find friends who shared my interests and with whom I could have a good time. If I kept myself too busy, I think it was mainly my own fault—and probably would have happened wherever I'd gone to school."

"U of C's social life has a reputation for being lackluster, but after all the smoke clears, it's really not bad. You won't find many raging parties, but you can definitely find people who enjoy what you enjoy, whatever that may be. There are a large number of intellectual social opportunities: three film societies, sci-fi clubs, gamers clubs, etc. There's a group for any interest; if the undergrads don't have one, the graduate students or professors do."

"People claim there is no social life here, but that isn't true. As always, it's what you make of it. First, there's Chicago—a great city with certainly no shortage of things to do. On weekend nights, a university-run bus goes downtown and comes back every hour until 3 a.m. The problem is that social things are not going to pop out at you. People who are involved (clubs, sports teams, student government) tend to be much happier here. You need to go out and find something to do, even if it is raining!"

"U of C is an intense place. The student seeking happiness here must find islands of activity within the prevailing grind. Seek out cool student groups. Go to student theater. Go downtown. Do what you need to do to avoid getting trapped into only studying and complaining about it."

"People often ask about security in this urban environment. The campus security is proactive, and that fact combined with a good dose of common sense can make the area very safe for students."

What Do You Like Best about U of C?

Above all else, reviewers noted the excellence of the education.

"The academics!!! The Great Books program is so rewarding. So much is derived from these books, I feel one **needs** *to have read them. I've learned a lot that I might not have learned without the core. In addition, the trimester system intensifies the educational experience."*

"The feeling of really getting an old-fashioned liberal arts education, the rigorous demands of reading all original texts, and the gorgeous campus architecture. I also had many rewarding experiences in Chicago—jazz, symphony, art, sports."

"The upper-level courses I took outside my major, 'The First Amendment,' 'American Law and the Rhetoric of Race,' and 'Conflict Theory and Aikido' were outstanding courses that made me think analytically in a non-scientific way."

"The flexibility of the academic program. Although there are many requirements, U of C is very accommodating about your other courses. I took many graduate-level courses."

What Do You Like Least about U of C?

Consensus: Life at U of C is not a piece of cake.

"Feeling guilty whenever not at work."

"Stress, the weather, the lack of free time, and inadequate advising resources."

"I regretted the no-double-major policy; it limited my opportunity to create a personally-tailored interdisciplinary course of study."

"School spirit is almost completely nonexistent. I wish there were more public happiness and joy, but it is a very stoic, serious place."

"Many U of C students are notorious complainers. They want everyone to believe the workload and weather are much worse than they are; then others will be amazed that they have endured U of C. The sun **does** *shine here, in fact, it's shining right now."*

Who Would Be Most Compatible with the Academic and Social Atmosphere at U of C?

Reviewers agreed that U of C is not for everyone.

"Someone who seeks academic life far beyond any social considerations, and who expects him- or herself and others to take their endeavors seriously."

UNIVERSITY OF CHICAGO

Chicago, IL 60637
(773) 702-8650

- 4-year private coed university
- Urban campus seven miles from downtown Chicago
- Full-time undergraduate enrollment 1996-97: 1,942 men; 1,624 women
- Special features: Gothic architecture. Research opportunities at nearby Fermi National Accelerator Laboratory and Argonne National Laboratories. Museum of Near Eastern Antiquities. The oldest documentary film society in the country.

"Someone with serious intellectual interests (particularly, abstract ones) who manages time well, is not apathetic, and doesn't get depressed when it's cold, wet, and windy. People who are willing to get involved will have lots to do. You don't need to know your interests before coming here."

"Serious, intense, self-assured, and smart!"

If You Had It to Do Over Again, Would You Go to U of C?

Most reviewers felt well rewarded for their academic labors, taking a great sense of pride and accomplishment in their undergraduate education. Three felt that the trade-offs with respect to social life and weather were greater than they would have been willing to make had they known them in advance.

"Yes. I learned a lot at U of C, but mostly I learned how to think and how to teach myself. I value my core experience; at another school, I don't think I could have been as well balanced while fulfilling a science major. It's probably true that, on average, more students have more fun at other schools. But given the quality of instruction and breadth of opportunity, it's worth working a little harder on your social life in order to be happy and succeed at U of C."

"Absolutely. I believe strongly in the value of a solid liberal arts education; to me, being educated isn't simply a matter of knowing one particular area well. While life at U of C is tough to get used to—the weather is cold, and the trimester system means that no time is spent fooling around—the academic opportunities are fantastic. If you're passionate about learning, it's a good place to consider because most people here share an emphasis on intellectual challenge and discussion."

"Yes. U of C offers an unsurpassed educational experience. It's not only that the students are smart and the faculty gifted; it's that there's no sense of complacency when it comes to achievement in academics. People are dedicated to their work in a very serious way."

"Yes. U of C is renowned for—and even perversely proud of—a notoriously poor social life, abominable sports programs, and maddening weather. The core curriculum is the most well-defined and, yes, restrictive in the nation. Nonetheless I am happy here. U of C boasts the most outstanding undergraduate education in the humanities and social sciences to be found anywhere, and I feel very lucky to be here."

"Yes. It gave me a rigorous education, and ultimately that's all that mattered to me. I hate Chicago, though. Why couldn't this excellent university be somewhere else? Sigh."

"No, I would have gone to Harvard. The location is better, and the more loosely organized core curriculum would fit my interests better. However, I feel that the intellectual (though not the social) atmosphere is better at U of C."

As you try to find the college or university best suited to you, the views of U of C presented above may be helpful. Keep in mind that these students might have had similar positive or negative experiences had they attended a different university. At any college, it is important to seek out challenging academic experiences and the best professors and to create a social life that fits your personal style. ■

Note: The students quoted in the College Review Series are expressing their own views, which are not necessarily those of JHU or IAAY.

CREATIVE MINDS

ImaGiNe...

Submit your creative work—brain teasers, short stories/essays/book reviews. We look forward to hearing from you.
Please write to *Imagine* • SET at IAAY • The Johns Hopkins University • Baltimore, MD 21218.

Andrew Davis *lives in St. Cloud, Minnesota, with his dog and his parents. This 16-year-old wants to become a famous computer game designer and live in a replica of the Millennium Falcon.*

Our apologies to the Bard, but this tongue-in-cheek story did make our editor laugh.

THE CHOICE

by Andrew Davis

"Already?" shrieked Is'khmael.

"As we speak, Professor," replied the young assistant. "There's no time to lift off on the cruiser—we've no choice but to photonize off Earth. I don't know why, but they won't wait for us. Hurry, Professor!" The young man dashed out the door even as Is'khmael rose from his chair to grab his belongings.

Such a wasted opportunity! Historians the galaxy cluster over had rejoiced when the Sol System—home to Earth, origin of the human race—was accidentally rediscovered while the government was setting up a new telecommunications line. Unfortunately, the historians' jubilation had changed to chagrin when the indifferent government then decreed that the historic system was "in the way of" the "far more important" communications project and would have to be removed. The researchers had been given only half a metric year to collect their data and move out.

Is'khmael had organized the attempt to collect significant Earth literature, expecting to reap fabulous treasures of prose. But thousands of years of neglect had obliterated all works save two lucky ones, each of which, needless to say, Is'khmael had pored over for hours.

Now, confound it, this excuse-for-a-government was apparently losing its patience with research and cutting off the project with weeks still to spare. He would exchange words with many a government official for this, that was for sure.

However, at the moment he had to concentrate on leaving the planet. He snatched up the two works, the last literary remnants of a great, but planet-bound, civilization and sprinted down the hall to the photonizer. This device would transport him from the small base they had constructed on Earth to the starship trillions of kilometers away, safe from the impending destruction of Sol.

Is'khmael slipped inside a compartment and entered the coordinates of his starship destination into the keypad on the wall. He closed his eyes, regretfully wished Earth good-bye forever, and waited for the transport.

Nothing happened. Opening his eyes in bewilderment, he saw the words "MASS TOO GREAT" flashing on a display.

Mass too great? Oh, yes, that's right. The inadequate photonizers they had purchased to cut costs could only handle a certain amount of matter; after all, why would they ever use the photonizers, anyway?

Is'khmael frantically searched for something to discard. Gladly would he remove his clothes for the sake of history, but if what the assistant had said was true, there wasn't enough time to struggle with the bulky suit he wore to protect him from the strange, dangerous gases on the long abandoned planet. It would have to be one of the books.

Is'khmael sighed. Better to leave with one valuable work than not to leave at all. Sadly, he tossed the heavy tome outside the small cubicle and reentered the coordinates. All became darkness....

***

Is'khmael stared stonily out the viewport at the gigantic fireball, all that remained of what had once been home to the first human life. He had left just in time, only seconds before the base, planet, and sun all became the rapidly receding light he now viewed. Curse the bureaucracy!

A colleague of his, Mil'teran, laid a hand on his shoulder. "I feel the same way you do, Is'khmael. This wasn't right. None of it."

Is'khmael blinked, holding back tears. "Mmmm."

Mil'teran sighed. He had heard Is'khmael's story, but had not gotten the details. "Which one was it you gave up?"

Is'khmael turned his head. Remorse was etched deeply into his face as he muttered, "According to my translation, the title was *The Collected Works of William Shakespeare*. I had only the one month to study it." His voice caught, and he fell silent again.

Mil'teran glanced across the small room to the table with the last remaining literature of Earth resting upon it. "At least you were able to save one," he said, eager to change the subject even a little bit.

Is'khmael simply nodded.

"Tell me, Is'khmael," asked Mil'teran, hoping to divert their attentions away from the tragedy before them. "Why was it you chose that one over *The Collected*—whatever?"

Is'khmael turned from the viewport, his face thoughtful. "Actually, I'm not sure. I read and enjoyed them both, but didn't think I had a preference. I had to make a split-second decision at the very end, though." He gazed over toward the table. "I think," he said, staring at the thin, brittle book with the word *Imagine* still visible after thousands of years, "I think that I just liked this one better." ✸

VOLUME • NUMBER
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Opportunities and Resources for Academically Talented Youth

March/April 1997

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Advancement of Youth

IAAY

Spotlight On

NAVIGATING OUR GLOBAL SOCIETY

Students in IAAY's Model U.N. class share both the challenge and the fun of debating global issues.

Photo by Vilma Lonsdale

We live in a global society. Economics, the environment, politics, business .... Today, few fields can be understood without an international perspective. Fortunately, navigating the globe gets easier all the time. You can jump on an airplane or take advantage of countless opportunities to connect with the world without leaving home. Libraries, groups committed to international concerns, all kinds of telecommunications resources, especially the Internet—they're all waiting for you.

Our writers in this issue of *Imagine* share their personal journeys toward global understanding. By doing research, participating in programs devoted to world issues, starting international initiatives, and traveling, they learned about life experiences other than their own. You, too, can have similar adventures. All you need is a desire to encounter the unknown and learn.

This issue also probes the exciting new career field of genetic counseling and the benefits of combining academics with athletics. Be sure to try the challenging puzzle from Tim Boester. So pick up *Imagine* as your map, and enjoy! 🌐

Wondering What You've Missed?

If you discovered *Imagine* fairly recently, you may be curious about the contents of previous issues. The following back numbers are still available and may be ordered from the Johns Hopkins University Press, while supplies last, at $4.00 per issue.

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Review of Princeton University
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Reconciling Feminist and Multicultural Awareness with Academic Programming in Schools

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If Classrooms Ran as Football Teams Run

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Also available, at $6.00 per copy, **Volume 4, No. 1 Planning Ahead for College**
Review of CalTech
Everything You Ever Wanted to Know ... Interview with a College Admissions Director

The following colleges were reviewed in Volume 1: Stanford, Johns Hopkins, Yale, Brown, Washington University (St. Louis). Although Volume 1 is sold out, ***Imagine* subscribers** may obtain copies of those five reviews at $5.00 per set.

To order back issues from Volumes 2 and 3, and college reviews from Volume 1, call (410) 516-7900 or (800) 548-1784.

Imagine is on the Web! Check out our home page: http://jhunix.hcf.jhu.edu/~setmentr/imagine.html

NOTE: We have been informed by Sandra Berger of the CEC that the Computerized Database of Summer Programs for Gifted and Talented Students, noted on p. 17 of our January/February issue, has been discontinued.

COMING ATTRACTIONS: *Imagine*'s May/June 1997 issue will focus on "Connecting with Computer Technology." Contents will include a student review of the University of Pennsylvania.

Want to subscribe to *Imagine*? Call (410) 516-7900 or (800) 548-1784 and ask about our introductory price.

Imagine...
*Opportunities and Resources for Academically Talented Youth**

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Craig Kielburger and Free the Children: Protecting Young People's Rights

by Lesley Mackay

Craig Kielburger
1996 Reebok Youth In Action Award

On April 19, 1995, Craig Kielburger, age 12, had just picked up his hometown newspaper, the *Toronto Star*, in search of the comics when a front-page headline caught his eye. "Child-labor Activist Slain for Defying 'Carpet Mafia,'" the bolded words read. The story about the life and death of a courageous Pakistani boy would transform Craig's life.

Iqbal Masih, Craig read, had been sold into slavery at age four. Barely a child, he was shackled to a loom in twelve-hour shifts and forced to tie tiny knots into fine carpets. Six years after he began this miserable life, Iqbal managed to escape with the help of a local anti-slavery organization. But he could not forget the children left behind. Attending school for the first time outside Lahore, Pakistan, Iqbal bravely began delivering speeches at home and then abroad about the horrors endured by child workers. Shot at age 12 when out on his bicycle, he died an international figure who had inspired a wave of concern around the world.

"Before I read about Iqbal," Craig says, "I wasn't in the habit of following the news. And I would have said that child labor had been abolished long ago. As soon as I read Iqbal's story, I realized how much I had to learn." That same issue of the *Star* contained a reference to a Canadian organization called the Youth Action Network. Craig contacted the Network staff, who sent him information and referrals to other organizations dedicated to human rights. Slowly, he began to accumulate what would become a mountain of clippings and reports about the exploitation of children. His activism had begun.

Creating Networks of Hope

As he was educating himself about child labor, Craig began to speak out to others and to form a core group of young people who wanted to do something about this injustice. He made presentations about Iqbal and child labor to his class, his church youth group, and his Boy Scout troop. From among those listeners, Craig formed the original membership of Free the Children. His new associates began reading, making contacts, and speaking to their own audiences. The group also launched a letter-writing campaign about child labor to Canadian newspapers. Three of the young writers' letters were published; shortly afterward, the *Toronto Star* ran a feature on this group of budding activists. In a few short weeks, Free the Children had reached hundreds of thousands of people with its message of concern about children who are forced to work.

"I wanted to inform and mobilize as many people as I could. So many children need help," Craig says, referring to a recent United Nations report that calculates that, around the world, 250 million 5- to 14-year-olds work at jobs, half of them full-time. Many endure the harshest forms of child labor—slavery, prostitution, and work in hazardous industries. Craig comments, "What happened to Iqbal was not an isolated incident."

Today, Free the Children is a rapidly growing international youth movement with adult associate members. The group advocates for children in part by empowering others who are uninformed or inactive. "Our campaign work is aimed not only at freeing exploited and abused children, but also at freeing ourselves from the belief that we have no role to play in society," Craig explains. Its dual focus could be described this way: young people have the right to protect young people's rights.

Free the Children's International Campaigns: Rugs ...

Free the Children helps bring the world's young people together through ambitious international campaigns. Thousands of Asian children are sold into slavery to produce hand-knotted rugs for export to North America and Europe. In Free the Children's "Rugmark" campaign, members disseminate information about a unique international trademark created by an Indian foundation. The Rugmark, stamped on hand-knotted Oriental rugs, establishes that the product was made by adults who were paid at least their country's minimum wage. This standard is legally binding for any manufacturer that utilizes the Rugmark, and compliance is monitored.

As part of the Rugmark campaign, Free the Children members conduct research into child labor in the rug industry and also educate their communities about this issue. Participants unite behind a range of actions such as letter-writing campaigns designed to convince retailers to trade only in Rugmarked carpets.

Iqbal Masih
1994 Reebok Youth In Action Award

... and Soccer Balls

Another campaign involves a product that many young people in developed countries possess: soccer balls. In league with other prominent groups such as the International Labor Organization, Free the Children has launched a letter-writing campaign directed at the International Federation of Football Associations, as well as at teams, schools, facilities, and other distributors and consumers of the balls. The purpose of the campaign is to mobilize soccer lovers to insist on soccer balls that are produced without child labor.

Posing and Responding to Tough Questions

As you read this article, perhaps you are wondering whether child labor might be necessary to build the economies of very impoverished regions of the world. Can child labor support a region's economic development, eventually helping to secure a better life for all? Free the Children poses such questions in its own literature, encouraging young people to think in a questioning way about the issues the organization raises. It also provides its own answers.

Child labor, the group believes, is typically exploitative. Children who work too young, too much, or in degrading or dangerous conditions are being abused. The consequences are long term, for their physical, social, and psychological growth is being stunted. At the same time, ironically, their labor is sapping their local and national economies, hindering true social and economic development. Why would this be so? In the first place, the wages that child workers earn are almost always abysmally low. Iqbal Masih was paid three cents for a twelve-hour shift at the carpet loom. Children who make sports equipment typically earn about six cents an hour. Perhaps most important of all, child laborers typically do not attend school. Child labor keeps hundreds of millions of children illiterate and uneducated. And child labor prevents the employment of adults, who would earn higher wages and would be much more likely to organize to insist on humane working conditions.

Seeking Answers Abroad

Craig Kielburger and his co-activists educated themselves about such points not only through reading and contacting international organizations, but also through networking with domestic organizations in many countries. They received a great deal of information by fax and e-mail from the South Asian Coalition on Child Servitude, with whom they eventually forged a strong working relationship.

Craig also began conducting his own fact-finding missions abroad. One unforgettable highlight of his experience was his first international trip—a seven-week mission to Asia for which he raised the funds himself by selling his toys and organizing garage sales. This mission included a visit to Pakistan, where he stopped in the outskirts of Lahore and met Iqbal's relatives. Since then Craig has traveled to Brazil and Haiti and has delivered speeches in many developed countries.

"It's one thing to hear about issues," says Craig. "It's another to meet children first-hand, to talk to them about their lives and about what they want." He continues, "My main inspiration is still Iqbal and everything he was able to accomplish."

The Possibilities of Progress

Like Iqbal, Craig has achieved a great deal in a short time. One of the most inspiring aspects of his story is that his work on behalf of children's rights began less than two years ago. Since then, he, like Iqbal, has become an international figure who has begun to change the world. Free the Children has mobilized young people, educated consumers, and secured commitments from companies around the globe. The group has also educated government officials on issues relating to child labor, urging them through petitions and then meetings to ban the import of goods produced by child labor and to pressure other world leaders to make the protection and education of children a priority.

"We started the organization with a focus on child labor and exploitation, but we are now fully committed to the implementation of the full spectrum of rights outlined in the U.N. Convention on the Rights of the Child. This, the most widely ratified U.N. Convention in the world, outlines the many rights to which children are fully entitled. One of them is the right to speak up." Craig adds, "In thinking about these rights, we encourage young people to work to improve their own local and national environments in addition to those of the international world."

Everything Craig and his associates have been able to do demonstrates that improving children's rights in any arena helps the cause of children's rights everywhere. 🌐

Good Causes that Span the Globe

You can educate yourself about world issues and get involved in activities that benefit different populations and environments by joining student groups sponsored by many organizations.

Some groups work on human rights:

Free the Children

For additional information on this group and its activities, check out Free the Children's growing Web site: *www.freethechildren.org*

To request a packet of information:

Free the Children
16 Thornbank Road
Thornhill, Ontario
Canada L4J 2A2

(905) 881-0863
fax (905) 881-1849
freechild@clo.com

Amnesty International USA, National Student Program

Involves young people from the United States in protecting the rights of citizens everywhere as those rights are expressed in the United Nations' Universal Declaration of Human Rights. Amnesty International (AI) is best known for its work in securing the release of prisoners of conscience, in supporting the prompt and fair trial of detainees, and in opposing torture and execution. In 1977 AI won the Nobel Peace Prize.

AI's 1,500 student organizations include 1,000 very active high school groups. Members participate in letter-writing campaigns on behalf of the human rights of particular individuals, help educate their communities about the rights of all citizens, and contribute to AI's many diverse projects and events. If there is not an Amnesty group at your school, consider starting one. See their Web site:

www.oneworld.org/amnesty/

For educational and training material, additional support, and guidance:

National Student Program
National Field Program Office
Amnesty International
1118 22nd St., N.W.
Washington, DC 20037

(202) 775-5161
fax (202) 775-5992
edorsey@aiusa.usa.com

☛ March 21st, 1997, is AIUSA's National Day of Student Action. Call the National Student Program for information on how you can participate.

Some groups work on the environment:

Sierra Student Coalition (SSC) of the Sierra Club

Helps young people educate themselves about the environment and become effective, responsible environmental activists. Founded in 1991 by a 17-year-old high school student from Los Angeles, the SSC is a national grassroots network of student environmentalists. SSC tailors Sierra Club resources for young people, creates national, regional, and local campaigns in which they can participate, and spearheads many other student-focused activities. For example, SSC advocates for Congressional awareness, corporate accountability, and citizen responsibility as the essential components of stewardship of the environment.

For more information, explore SSC's Web site: *www.sierraclub.org*

Sierra Student Coalition
223 Thayer Street #2
Providence, RI 02906

(401) 861-6241
fax (401) 861-6241
ssc-info@ssc.org

And some groups work on human rights and the environment:

Rainforest Action Network (RAN)

Works to protect Earth's rainforests and to support the rights of their inhabitants through education, grassroots organizing, and nonviolent direct action. Tour their Web site: *www.ran.org*

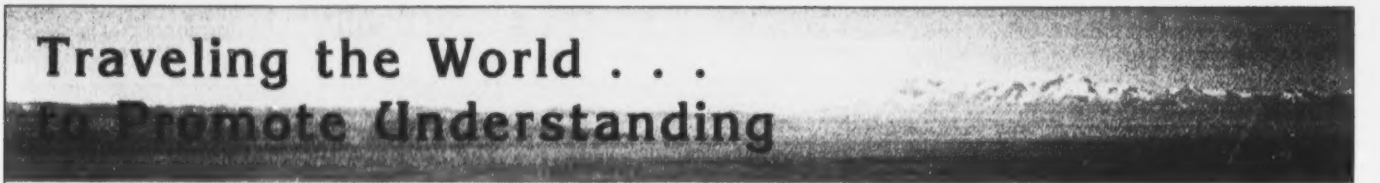
For students in tenth grade and above: To become a Rainforest Action Network member or join in specific action campaigns, write or call RAN.

For students in ninth grade and below: To learn more about the earth's rainforests, the forces affecting them, and the populations that inhabit them, write for Rainforest Action Network's Kids' Action Guide. The Guide contains important facts and actions you can take now. To receive the Guide, send a letter and $4.00 to:

Rainforest Action Network
Information Department
450 Sansome Street, Suite 700
San Francisco, CA 94111

(415) 398-4404
fax (415) 398-2732
rainforest@ran.org

For additional related Web sites:
jhunix.hcf.jhu.edu/-setmentr/links_44.html



Traveling the World . . . to Promote Understanding

AFS Team Mission to Bolivia: An Experience to Live By

by Diana Rutowski

It's 4:00 a.m. in Bolivia, and nine American teens rise grudgingly from their beds. To avoid being blinded on the roads by the rising equatorial sun, our bus driver must leave by 4:30. In a daze, we shove our things into backpacks and pile onto the bus to head back over the mountains to La Paz. Townspeople fill the seats and aisles to maximum capacity, taking advantage of the unexpected ride we're offering.

My companions and I are spending the month of July in Bolivia with an American Field Service Team Mission. Traveling around this diverse country and living with the local inhabitants, we experience firsthand the daily lives of the descendants of the Aymaran, Incan, and Tihuanacan people. They share stories of their religious, social, and political heritage with us; we lend a hand wherever we can.

We have just spent the last few weeks in the subtropical Andean region, the Yungas. The previous day I hiked for four hours to a field with a young girl named Christine. Not much older than I am, she carries her baby to her coffee and coca fields every day. She led the way in brightly colored skirts and sandals with small heels; I followed in jeans and sneakers.

On the side of a mountain, we stopped to gather coffee beans and coca leaves. After tying her bundled-up baby to the branch of a tree, Christine showed me how to fasten a sheet into a bag around my waist and how to decide just what was ripe enough to pick. As my back began to ache and my skin to itch from insect bites, I was sharply conscious of the contrast between her daily life and mine.

All morning we chatted in Spanish—not the primary language for either of us—as I helped her with the job she usually does on her own. She explained that the people of her town, Chirca, harbor negative feelings toward the U.S. and its foreign policy. Coca, historically important in Bolivia's economy, has many uses in their traditional medicine and religious rituals. The U.S. government's disapproval of Bolivia's coca cultivation threatens her people's way of life.

Indigenous people picking coca leaves in the Yungas.

At night we returned to the town, where all the children were playing in the square. My group joined in the festivities. The children taught us games that resembled those we played as kids, such as "Duck, Duck, Goose" and "Ring around the Rosy" until bedtime at 10 p.m. The local families did not have the space or food to house us individually, so we stayed in an old building once used as a medical clinic. After a long, tiring day, we slept well in our sleeping bags on the hard floor.

Back on the Bus

The bus draws to a stop, jolting me back into consciousness. We have arrived in La Paz, ready to begin the second half of our mission. Here we separate to stay with families from Bolivia's upper class. All have students our age who are applying to travel to the U.S. with AFS, a very competitive process. My host mother works in a public office downtown, and my host father is in the military. My brother, Guillermo, takes me with him to his private school. Students range in age from about 10 to 18. We stay in the same classroom with the same students all day, while the teachers move in and out.

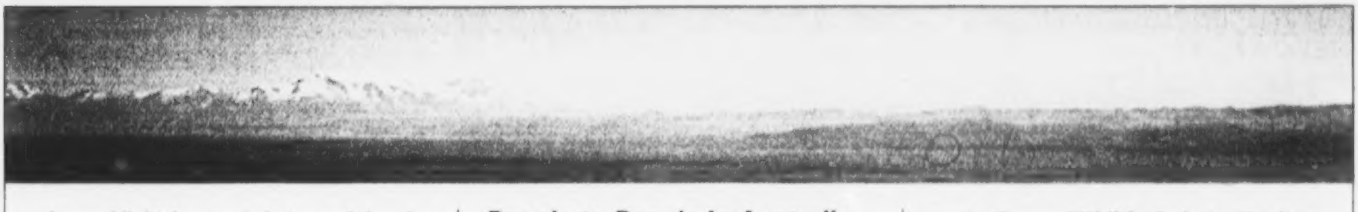
After a few days in the city, we head across the high Andean plateau called the Altiplano to almost unfathomably deep Lake Titicaca, which extends into Peru. There we visit reforestation projects and learn about the history of the people. We stay at the Aymara University in small dorm rooms with four beds, which occupy nearly all the floor space. In winter and at such a high elevation (13,000+ feet), it is cold. There is no heating, so we bundle up in layers in our sleeping bags.

On day trips, we ride in the dusty bottom of a huge truck over dirt roads to some of the university's projects. One is a potato field with an experimental irrigation system. By design, the canals are underground and a specific distance apart to insure that the water never freezes and is in continuous supply.

The sun shines every day, and the sky is remarkably clear. On a free day, two other students from my group and I set out to climb a mountain we can see in the distance. After a couple hours of walking along the roads, we realize that the distance is deceiving, but we are determined. We hike across fields, leap over streams, and finally arrive at the base of the mountain. After climbing halfway up, we look over our shoulders and see an absolutely magnificent view of Lake Titicaca. We feel on top of the world. As we bask in the beauty of our surroundings, we realize that the sun is descending behind the mountains. We walk back in the dark, but I don't notice the falling temperature because I feel wonderful after such an exhilarating day.

Heading Home

Before I arrived in Bolivia, I knew only a few facts about the country: that it has undergone many political revolutions; that native people constitute more than half its population; that La Paz, at 13,000 feet, is



the world's highest capital city; and that the lack of oxygen at this elevation prevents fires and the need for a fire department. But none of these facts had prepared me at all for the richness of the country and its cultures.

The American students in La Paz

Now, as the end of our mission approaches, I reflect on how this experience has changed my view of the world. I am far more aware of how the decisions we make as members of a global community affect everyone on this planet. For example, I have seen firsthand the practice of deforestation to create grazing lands for the eventual benefit of burger chains. And I have learned how the effects of deforestation combine with those of carbon dioxide emissions from factories and car exhausts to contribute to global warming. I don't plan to stop eating meat or driving a car; however, I hope I am becoming a more conscientious consumer. And as a result of this incredible trip, I am eager to experience more of the different cultures of this world. ⊕

For more information about AFS programs: (800) AFS-INFO; www.afs.org/usa

***Diana Rutowski**, now a freshman at the University of Arizona, is considering majoring in philosophy and international relations. Following graduation, Diana hopes to join the Peace Corps before attending graduate school.*

People to People in Australia

by Bill Loth

Believing that individual friendships can lead to world peace, President Eisenhower founded People to People in 1956 for students in grades 6–12. My People to People delegation included 34 students and 6 leaders from Pennsylvania and Ohio who traveled together. Our experience as Student Ambassadors began in Canberra, Australia's capital, where we absorbed a lot of history while visiting Parliament House and the Australian War Memorial. At the national wildlife park, we saw exotic animals not found anywhere else in the world, including kangaroos, emus, koalas, wombats, and a tasmanian devil. Then we moved on to Sydney, the country's largest city, where we toured the famous Opera House, took a cruise in Darling Harbor, and ate at the Hard Rock Café.

Next came one of the best parts of the trip: the two homestays. The Australian people are very hospitable and friendly, and they made us feel at ease in their homes. We toured a school with our first host families and learned some new games such as rugby and handball.

At Bunya Wildlife Park in Yandina, Queensland, we had our photo taken with a koala, took a bumpy ride on a camel, and explored the colored sands—73 different colors! Another highlight was our visit to the Dreamtime Aboriginal Center, where we threw boomerangs and experienced the Aborigine culture through their dances and stories. After exploring Olsen's Capricorn Caverns, a series of caves thrust above ground in ancient times by geologic stress, we camped on a cattle farm in the Australian Outback. Finally, we reached the Great Barrier Reef, my favorite place, where we saw over 400 kinds of coral (some 900 years old), a giant clam, and many brightly colored fish.

After three busy weeks, I was tired, but I had learned a lot about Australian culture and lifestyles—and I had gathered memories that will last a lifetime. ⊕

*Ninth grader **Bill Loth** attends Hollidaysburg Area Junior High School in Pennsylvania. He plans to become an accountant and looks forward to the future.*

For more information: People to People, (509) 534-0430, fax (509) 534-5245.

Sony Student Project Abroad (SSPA)

To improve cross-cultural understanding and to encourage students' pursuit of industry-related careers in math and science, Sony Electronics (U.S.) and the Sony Corporation (Japan) jointly sponsor SSPA, an 18-day, all-expenses-paid, educational and cultural trip to Japan for 50 U.S. 11th and 12th graders. SSPA participants tour manufacturing facilities, attend presentations on design and engineering, visit historical and cultural points of interest, and enjoy a home-stay with a Japanese family.

SSPA participants must be nominated by their U.S. Senator, each of whom is invited to nominate one student every other year. Check to see which year your state is eligible:

Leslie Gaffney, Project Manager, Sony Student Project Abroad, 1 Sony Drive, Park Ridge, NJ 07656; (201) 930-7538.

For additional travel and study abroad options:

Advisory List of International Educational Travel and Exchange Programs 1996-97
($8.50)
Council on Standards for International Educational Travel, 3 Loudoun Street SE, Leesburg, VA 20175; (703) 771-2040.

Debating World Issues . . . and More

by Brian Milch

The classroom was packed. Students filled the desks and overflowed to the windowsills, the freshmen glancing around with eager and slightly awed looks, the upperclassmen chatting with friends and looking cool but still excited. It was the first meeting of my high school's largest club, Model United Nations, and I was one of the eager freshmen. The hubbub died down as the president welcomed everyone to the club and began to introduce the senior members. I didn't know exactly how Model U.N. worked at that point, but I knew that I loved to argue, and I saw those seniors as exemplars of debating power.

Starting Out as a Novice

To get new members up to speed, the club offered a series of workshops on essential skills such as researching a country's policy, writing a U.N. resolution, and using the parliamentary procedure that would govern our committees. I was assigned to represent Zimbabwe at my first conference, so I began to read up on the country's history, economy, and government, trying to predict what its policy would be on international issues. Appointed to the Legal and Political committee, I wrote a resolution calling for a ban on pollution of air or water that crossed international boundaries, on the grounds that such pollution was essentially dumping toxic substances on another country's territory. Having recently taken a CTY summer course in logic, I felt confident that I could defend my resolution with bullet-proof reasoning.

By the time the conference rolled around, I was ready to rock the house. So I was shocked when the first speaker concluded his speech by saying, "I know that this is an imperfect resolution and would welcome any suggestions for amendments to improve it." It was then that I realized Model U.N. was not a debate club where people took sides on a static resolution, but rather a simulation of real policy-making bodies where the final product is almost always a compromise. It turned out that in amendment negotiations, which often occurred in informal caucus sessions, diplomacy and tact were paramount. Although there wasn't time at the conference to debate my own resolution, I began to see how much more there was to Model U.N. than trying to crush the other delegates in debate.

Looking Back as a Seasoned Delegate

In my four years as a Model U.N. member, I attended eleven conferences, including three of the annual conferences held at Harvard University, which draw thousands of students from all over the world. I moved beyond Zimbabwe to represent Brazil, Belarus, South Africa, and China, and finally to chair a committee at a local conference. One of my most challenging assignments was to represent China—the world's largest producer of pirated music and software—in a discussion of intellectual property protection. Experiences like this didn't necessarily convince me that the policies I had to defend were right, but they did teach me to see complexity in issues that might once have appeared black-and-white.

Model U.N. certainly improved my speaking skills and made me a polished debater—after four years in Model U.N., I will never again fear making a speech. More importantly, I became adept in diplomacy, the art of making a point persuasively without offending anyone. This skill has served me in good stead not only in Model U.N., but in everyday social situations as well. Another skill I learned from Model U.N. was how to recognize bias in the sources I used to gather information on current issues. For instance, there was a time when I needed to do research on the Isle of Kardak, a rock in the Aegean Sea whose ownership is disputed by Greece and Turkey. The only information I could find on this rather obscure topic came from the Web sites of the Greek and Turkish foreign ministries. Each country had its own version of the conflict's history; they each omitted information that didn't support their views and even contradicted each other directly on some points. Being aware of the bias in the two sources allowed me to piece together my own analysis of the situation.

Beyond teaching me specific skills, Model U.N. gave me an awareness of global issues and an ability to see these issues from multiple perspectives. Now almost-subconscious, this awareness manifests itself in my strong interest in international news and a tendency to view foreign policy from an international rather than nationalist perspective.

In fact, I think this awareness is the most valuable thing I have taken from Model U.N. Skills in research, debating, and diplomacy can be acquired separately. Yet, Model U.N. is probably unique in creating the kind of immersion in global issues that leads to a lifelong international perspective. 🌐

Brian Milch is now a freshman at Stanford University, where he plans to major in Symbolic Systems, an interdisciplinary study of thought and information processing in both human minds and computers. A member of the Stanford Model U.N. Club, Brian is helping to get a conference off the ground and planning outreach programs for area schools.

First-time Diplomacy at Model U.N.

by Jessie Withrow

I first became interested in political science when I spent the summer after 9th grade listening to *Monitor Radio* and *Talk of the Nation* on National Public Radio. That fall, spurred by stirring accounts of the diplomatic exploits of John Major and Bhoutrous Bhoutrous-Ghali, I eagerly signed up to participate in the 1996 Alaska Model U.N. conference, choosing to be a member of the Japanese delegation.

The topic for the conference was maritime law, an issue of great concern to an island nation like Japan. I opted to serve on the General Assembly Third Committee (GA3), which covers humanitarian concerns. For the 1996 conference, GA3 focused on whaling and subsistence fishing rights.

Japan has historically been a major producer and consumer in the commercial whaling industry. Although the Japanese have ceased commercial whaling, they continue to harvest a limited number of whales every year to monitor changes in whale populations. Only by obtaining accurate data on the age and sex distributions within each whale population is it possible to predict the future sizes of those populations. However, the fact that, after being studied, the harvests of scientific whaling boats usually end up in Japanese fish markets has led many to believe that scientific whaling is no more than a smoke screen for illicit commercial whaling. Representing Japan on GA3 promised to be challenging.

The first day of the conference a few months later found me feeling anxious and woefully unprepared. My research efforts had not been as thorough as I'd intended, and I was nervous about whether I had enough information to represent Japan well and to justify scientific whaling.

From the beginning, it was clear that most of my fellow delegates considered whaling—for any reason—fundamentally unethical. Not only that, but my position on whaling was so antithetical to theirs that many delegates were reluctant to support me even on non-whaling issues because they saw me as "the enemy." I felt as though I were fighting a single-handed battle against the rest of the United Nations.

By the end of the first day, I was absolutely exhausted. My throat felt drier than the Mojave, and I thought I would scream if anyone ever again asked me to explain scientific whaling. If I'd had the option, I might not have returned the second day. But my sense of duty prevailed; the next morning, I buttoned up my nice white blouse, pulled my hair into a no-nonsense bun, and set out to face another day of parliamentary procedure and political maneuvering.

That second day was a completely different experience for me. When I began Model U.N., I was so nervous that someone would discover my areas of ignorance that I tried to say as little as possible. But after watching the process, I realized that success in Model U.N. has less to do with knowledge about international relations and "the issues" than it does with diplomacy and arguing your case well. Being informed is important, of course, but it does you little good if you don't know how to use your knowledge to persuade other people to your side.

When I began to fight for my cause, Model U.N. stopped being an ordeal and started being fun. During the second day of the conference, I made an ally in the Argentinean delegation, worked furiously to pass a pro-whaling resolution, and debated another resolution in front of an auditorium full of delegates. By becoming active and taking risks, I let surging adrenaline obliterate my negative feelings toward Model U.N.

I didn't succeed at Model U.N. in the sense of being chosen Outstanding Delegate or passing a lot of resolutions; that was really too much to expect my first time around. But I succeeded in learning a lot about international relations and how diplomacy works. Choosing to represent an unpopular stance in a controversial issue my first time as a delegate may not have been wise, but it gave me an opportunity to learn what it's like to be in the minority. When I first signed up, I was as opposed to whaling as any of the delegates on my committee, but after learning more about it, my views on the subject are more moderate and reasonable.

Model U.N. was an exhilarating, exhausting, and fascinating experience for me, one that I would eagerly recommend to other students and would just as eagerly repeat. 🌐

A junior at Steller Alternative School in Anchorage, Alaska, **Jessie Withrow** *writes for the local newspaper and is taking her third clinical science class at the University of Alaska. She is now preparing to serve in the Canadian delegation to the 1997 Alaska Model U.N. conference.*

The international Model United Nations Program encourages students from grade 6 through graduate school to explore global concerns and develop leadership skills through the principles of the democratic process. In settings that can range from classroom events to multi-school conferences, club members role-play diplomats and debate current international issues in simulations of U.N. activities. Drawing upon information gathered during intensive research and preparation, each member represents a nation and advocates for that nation's policies.

For information and how-to publications on starting a Model U.N. Club in your school:

Melanie Andrich, Education Department, United Nations Association of the United States of America, 485 Fifth Avenue, New York, NY 10017-6104; (212) 907-1326, fax (212) 682-9185;
e-mail: unany@igc.apc.org Internet: unausa.peak.org

*As America's population becomes increasingly diverse, the health of our society depends more than ever upon transformation from old, painful patterns of prejudice and bigotry. Out of this need for mutual understanding has come one exciting new extracurricular program at the Illinois Mathematics and Science Academy.**

PEER MULTICULTURAL EDUCATORS

Agents of Change in a Diverse Community

by Sindhu Revuluri

"Define diversity."

Among the other, more traditional questions on the application form, this one stood out. So simply stated; answering it would be a piece of cake, I thought. We were free to use any form of expression, so I drew a rainbow and wrote something about differences blending to be beautiful. But the more I thought about the question, the more what had seemed like such a simple task began to feel overwhelmingly complex.

So too, I later learned, was the task of becoming a peer multicultural educator—simple at first glance, but infinitely complicated in its applications.

Confronting Prejudice

The organization Peer Multicultural Educators (PME) was created at IMSA in 1992 by a resident counselor because of his personal interest in multicultural issues and in response to growing student curiosity and concern. Originally designed as a two-year program, PME recruited members from both minority and non-minority groups. As the name suggests, its goal was to have students educate their peers about various forms of prejudice and about the dangers and injustice that arise from them.

To achieve that goal, we PME members first had to educate ourselves and examine our own prejudices. We began this process during the first year with readings, films, presentations, and discussions about our own life experiences. I had just entered IMSA and was scared of everything—of living away from home for the first time, trying new things, and feeling different from everyone else. I had grown up feeling different and hadn't always been treated kindly. I told about being teased and nagged about my name, how I looked, the clothes I wore, how well I did in school—things that, rationally, should have made me feel proud. Other PME members shared their stories as well: from not being served at restaurants, to getting beaten up, to hating themselves for being different.

The range of races, cultures, and life experiences among IMSA students made sharing these stories especially interesting and worthwhile for all of us. But the PME members who were most shocked by these stories were non-minority students who had come from fairly homogeneous communities such as those in most of central or southern Illinois. Open-mouthed, they listened in disbelief that such things could happen to those they knew. Even non-minority students who came from fairly diverse areas found it hard to fathom.

Becoming an Ally

Listening to these stories helped us recognize and work to overcome our own prejudices. But there was more to do. During the first year, we were also challenged to expand our vision to those around us, to become agents of change among friends and family through our own behavior and personal interactions. We began training to be "allies," to support individuals and groups who are victims of society's prejudices. The directions we were given seemed obvious and fairly simple ... until I had to *be* an ally.

I was at a dress rehearsal for an off-campus group. The stage manager, who had a high-pitched voice and rather feminine gestures, walked by. "What a fag," someone said bitterly and then chuckled to herself. I turned to her and asked, "Do you know what a fag is?" "Sure," she replied. "It's a gay guy." "Not really," I said. "Actually, it's a little bundle of wood used in colonial America to burn homosexual men at the stake because of their sexual orientation." She looked a little sick and said, "Oh."

I turned back around and took a deep breath. Then I smiled. By standing up for that man and not conforming to the social situation, I had acted as an ally. Although it sounds like a small act, it was one of the hardest things I have ever done. But it was a necessary and powerful step, building my confidence to act in the future.

Expanding Our Role

During the first year of PME, we acted informally as educators by changing our own behavior among family and friends. In the second year, our mission as agents of change expanded, and we became educators in the more formal sense. To inform more of our peers about multicultural issues and induce changes in their behavior, we decided to hold a PME day for students from IMSA and other area high schools. PME members chose different styles of presentations and led workshops on such topics as racism, sexism, homophobia, and classism.

Continuing the Mission

Training to be a peer multicultural educator helped me to feel proud of what is unique about me and to gain the strength to be an effective ally for others. I have learned to view the world from a different perspective, to look at someone's mind and spirit, rather than at race or age or physical ability.

I have continued to struggle with my definition of diversity. What makes a campus or community diverse? PME taught me that a population is not diverse simply because it boasts of having people of many different races, ethnicities, ages, abilities, religions, cultures, and life experiences. True diversity requires expecting and encouraging interaction among such people, seeking harmony in that interaction, and truly appreciating differences. Groups that can interact with one another without losing their individual identities form something quite beautiful—just like the rainbow. ⊕

If you're interested in starting a program like Peer Multicultural Educators at your school, you may obtain information from Clair Null: clair@imsa.edu

Sindhu Revuluri is a freshman at Smith College, planning to major in government and music. She serves as a campus senator and on the Curriculum Committee Executive Board, and volunteers at the Northampton Community Music Center.

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* *IMSA is a three-year public residential high school for students talented in math and science.*

The United States, perhaps uniquely among nations, boasts a population that reflects cultural, ethnic, and religious heritages from around the world. This author is struggling with issues common to many Americans who live primarily in one culture but have strong ties to another.

The Cultural Ambivalence of a Hyphenated-American

by Catherine Foo

I was born in the U.S., but until I was four, I never spoke a word of English. Because my parents are immigrants, I was brought up in a Chinese microcosm—among aunts, uncles, cousins, and friends—where Chinese was everyone's first language. When I was sent to an American preschool, I spent the entire first day crying. Not only was I surrounded by unfamiliar faces, but their language was completely foreign to me.

Soon thereafter, I experienced another first day—at Chinese school. Of course, I understood the language spoken there. But on Saturday mornings, all my friends could sleep in or watch cartoons, while I had to get out of bed as I did every school day, to sit in a classroom for three and a half hours. I hated it.

This school, like many across the U.S., was created by parents who wanted their children to retain their heritage, to study the Chinese culture and language, and to interact with other Chinese children. I went because my parents wanted me to go. With their encouragement, I placed first or second in my class through elementary school. But, like my classmates, I resented the extra class time and homework, and wasn't very involved in what was being taught.

A Spark Flickers . . .

Then, when I was in 8th grade, I had a strange experience. I was asked to plan some parties and field trips for Chinese school. As I began to look for more culturally oriented activities, I noticed something startling: everyone I was contacting, everyone who knew about Chinese culture, was a native Chinese. The teachers in the school, my classmates' parents—they had all been born overseas and had immigrated to America as adults. Decades later, they were still running the Chinese schools and enrolling their American-born children in classes we didn't want to attend.

I realized that few, if any, of us would ever return to the Chinese school system. We had grown up with varying degrees of bilingual ability: some were fluent in Chinese; others could barely stammer out a few sentences. Most of us didn't have the skills to do our own homework, let alone teach others. Running Chinese schools was our parents' business. When we became parents, whose business would it be?

Stunned by this realization, I decided to enlarge my original goal. Field trips and parties were fun, but I had a greater idea: I was going to help change a generation. With limited help from my classmates (who rolled their eyes at any suggestion that they spend more time on Chinese school), I drew up a proposal for a series of student conferences and the creation of a network for educators, to be facilitated by students.

Projects based on lofty ideals often fail, and mine was no exception. Once I entered high school, I fell prey to the flurry of deadlines and to-do lists. My Chinese school project tumbled from my list of priorities. Without the support of other students excited about their Chinese education, the idea slowly dissolved.

And Ignites . . .

I am approaching the end of my twelfth year of Chinese school. My original kindergarten class of twenty has dwindled to a handful of students who appear only sporadically, missing class for SATs, sports, band practice, or just to sleep in. Few of us have time for Chinese homework; coming to class takes enough effort in itself.

Yet, occasionally, something rekindles my interest. Over the dinner table, listening as my parents debate the traditionally correct way to address a second cousin once removed on the mother's side; at a museum, browsing through seemingly endless rooms of Chinese art; in a classroom, reading the *Tao Te Ching*. Moments like these draw me back to my Chinese legacy.

And, I find, I am not alone. Ironically, after resisting Chinese education for years and years, American-born Chinese often go off to college and do the previously unthinkable: take Chinese courses on their own. When I first heard that my older friends were enrolling in these classes, my reaction was one of bewilderment. Why, if they didn't have to, would they be studying Chinese?

Sometimes I wish I still possessed the fluency I had as a small child. These days, I speak to my parents in "Chinglish," inserting English words and phrases where the Chinese slips my mind. This has become a habit, making it difficult for me to carry on a substantial conversation with someone who understands little or no English. Perhaps it is too late to salvage my former fluency, but I find myself pursuing my heritage in other ways. I have taken classes in Chinese brush painting, calligraphy, dance, and am learning to perform a Chinese yo-yo.

And I think I am beginning to understand. All these years, my classmates and I have been bored by Chinese school, resisting learning about what we considered to be our *parents'* culture, not ours. Absorbed in the present, we have been indifferent to the past. Now we are beginning to move out of the sphere of our family's influence and into the larger world on our own. Only now have we begun to realize that Chinese culture is a part of ourselves we cannot afford to lose. 🌐

Catherine Foo, an 11th grader at Lower Merion High School in Ardmore, Pennsylvania, is currently a volunteer translator between visitors and artisans at a Franklin Institute exhibit, "China: Ancient Arts and Sciences." She is also a pianist, artist, and Science Olympiad captain.

Cycles of

To tackle some global problems, you need to know history, diplomacy, economics, or languages. But some of our most serious planetary challenges must be understood scientifically before they can be addressed politically. This is one such story, and it provides the background for the article that follows.

It takes courage to publish inexplicable data. Scientists prefer to wait until they have a plausible explanation for their findings before going public. But in 1985, researchers at a British Antarctic Survey (BAS) station released data that they themselves had trouble believing.

Since 1977, they had been recording low ozone levels high above that frozen continent every antarctic spring. But they hadn't alerted the scientific community because the numbers were so low that they seemed sure to be the result of some sort of equipment malfunction. However, when a sister research station a thousand miles away recorded similarly low readings, BAS scientists decided they could no longer doubt their data.

Earth's Protective Shield

Why is ozone depletion a matter for concern? Ozone makes up less than one part per million in the atmosphere. If all the ozone were compressed into a layer, it would be only 3 mm thick. Yet it plays a vital role in protecting life on Earth. Ozone is concentrated in the stratosphere, 20-30 kilometers above Earth, where it absorbs ultraviolet (UV) radiation from the sun. UV radiation damages DNA not only in higher organisms but also in plants and marine phytoplankton, life forms at the bottom of our planetary food chains. Damage to those species could threaten life on Earth.

Ozone (O_3) is formed in the stratosphere. When UV energy is absorbed by an oxygen molecule (O_2), it splits into two high-energy atoms of oxygen (O) which quickly react with an O_2 to form O_3:

$$\begin{array}{lll} & O_2 + UV & \rightarrow 2O \\ & O + O_2 & \rightarrow O_3 \\ \text{net:} & 3O_2 + UV & \rightarrow 2O_3 \end{array}$$

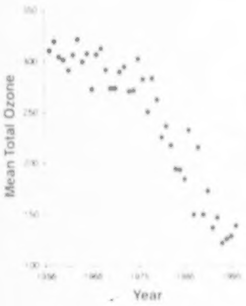
Ozone is then able to absorb additional UV radiation without being destroyed in the process:

$$\begin{array}{lll} & O_3 + UV & \rightarrow O_2 + O \\ & O + O_2 & \rightarrow O_3 + \text{heat} \\ \text{net:} & O_3 + UV & \rightarrow O_3 + \text{heat} \end{array}$$

Stratospheric ozone is constantly being formed, split, and reformed, absorbing most of the sun's UV energy before it can reach Earth's surface. Ozone concentrations reflect the complex, ongoing balance between its creation and destruction.

Ozone and CFCs

The 1985 BAS announcement was not the first time ozone had made headlines. In 1974, chemists Sherwood Rowland and Mario Molina warned that a widely used family of man-made chemicals called chlorofluorocarbons (CFCs) could cause depletion of stratospheric ozone. (In 1995, Rowland and Molina won the Nobel Prize in Chemistry for their pioneering work.)



Plummeting Ozone Levels
Mean ozone measurements for the month of October from the BAS station at Halley Bay. (Data courtesy of J.D. Shanklin, BAS)

Until 1974, CFCs were considered wonder chemicals: inert, cheap to produce, and useful in many ways. Their low freezing point makes them excellent refrigerants, while their stability makes them safe for use around humans. But ironically, their much-valued stability also makes them dangerous. In the lower atmosphere, they remain intact for decades. No natural process breaks them down. And they don't dissolve in water, so they aren't washed out of the atmosphere by rain. They just keep building up.

Eventually, turbulence carries them up into the stratosphere. There, like O_2, CFCs are split by UV radiation, releasing highly reactive chlorine atoms (Cl) which catalyze ozone destruction. Fortunately, other molecules in the stratosphere also react with Cl. Some form stable compounds, thus "trapping" it. Rowland and Molina estimated that, over time, CFCs would catalyze a 3-7% depletion of global ozone. But that estimate assumed that Cl, once trapped, would remain trapped.

Inside the Polar Vortex

During the antarctic winter, a tight, circular wind pattern develops over the South Pole. This polar vortex isolates the antarctic air mass from the rest of the Earth's atmosphere, and temperatures in the lower stratosphere drop below -80° Celsius. Under these frigid conditions, unusual *polar stratospheric clouds* (PSCs) form, composed of frozen crystals of nitric acid and water.

In the presence of PSCs, chlorine is released from its traps. To make matters worse, PSCs also remove from the atmosphere the molecules that trap chlorine. PSCs thus play a doubly destructive role: releasing large quantities of chlorine (Cl_2) into the stratosphere and depleting the molecules that could retrap it.

When sunlight returns to the Antarctic in the spring, it sets off a cascade of destruction. The Cl_2 built up during the winter absorbs UV energy and splits into Cl atoms, which then destroy ozone. And because PSCs have depleted the Cl-trapping compounds, each Cl destroys thousands of ozone molecules before being retrapped.

In time, sunlight warms the antarctic air and PSCs evaporate. The polar vortex dissolves. However, the dilution of the surrounding air by ozone-poor antarctic air contributes to the recorded decrease in global ozone levels.

A Global Problem Requires a Global Solution

Fortunately, the global community acted fairly quickly to understand and then to do something about the problem. An international agreement limiting the production of CFCs was signed in 1989, then made stricter in 1992. But even with these restrictions, atmospheric CFC levels will increase until at least 1998. The ozone hole over Antarctica will get bigger before it gets smaller. If all goes as expected, natural processes should regenerate the ozone layer in 50–100 years.

But will all go as expected? The ozone hole was a wake-up call that forced the world to face the fact that our activities have environmental consequences we do not anticipate. Because we do not yet fully understand our planet's complex systems, we must vigilantly watch for changes. The safety of life on Earth may depend on it.

—Carol Blackburn

Destruction

by Shaumo Sadhukhan

Four years ago, I began an independent science project on ozone depletion in the antarctic stratosphere. I chose this topic because I wanted to study a cutting-edge problem with major implications for humanity. In the decades to come, depletion of the Earth's ozone layer by chlorofluorocarbons (CFCs) and other chemicals could threaten the existence of civilization as we know it.

How Ozone Is Destroyed

Initially, I visited libraries to immerse myself in the literature on this subject and soon began to understand the pathways of ozone depletion. Ozone is destroyed by chlorine (Cl) released when CFCs rise to the stratosphere. There, these normally inert compounds are broken apart by UV light:

$$\mathrm{CFC} + \mathrm{UV} \rightarrow \mathrm{Cl} + \text{others}$$

Some released Cl atoms remain free, while most react with ozone to form chlorine monoxide (ClO):

$$\mathrm{Cl} + \mathrm{O_3} \rightarrow \mathrm{ClO} + \mathrm{O_2}$$

Free Cl also reacts with hydrocarbons to form hydrochloric acid, and ClO combines with nitrogen dioxide to produce chlorine nitrate:

$$\mathrm{Cl} + \mathrm{CH_4} \rightarrow \mathrm{HCl} + \text{others}$$
$$\mathrm{ClO} + \mathrm{NO_2} \rightarrow \mathrm{ClONO_2}$$

Chlorine nitrate and hydrochloric acid serve as reservoirs that trap Cl. At middle latitudes, Cl remains in these reservoirs; thus ozone depletion is minimal. Each Cl may destroy only a few ozone molecules before being trapped in a reservoir.

However, above Antarctica, conditions allow for the existence of polar stratospheric clouds (PSCs), which promote massive destruction of ozone by freeing Cl from reservoirs. PSCs provide a surface on which hydrochloric acid and chlorine nitrate react, releasing molecular chlorine:

$$\mathrm{HCl} + \mathrm{ClONO_2} \rightarrow \mathrm{Cl_2} + \mathrm{HNO_3}$$

Cl_2 breaks apart into Cl atoms in the presence of UV radiation. Subsequently, Cl destroys ozone through the ClO-ClO catalytic cycle. Two ClO molecules combine to form a dimer, and UV rays split the dimer into Cl atoms and oxygen:

$$\mathrm{ClO} + \mathrm{ClO} \rightarrow \mathrm{Cl_2O_2}$$
$$\mathrm{Cl_2O_2} + \mathrm{UV} \rightarrow 2\mathrm{Cl} + \mathrm{O_2}$$

The Cl atoms then reenter the cycle and the process continues, destroying many ozone molecules. Furthermore, in the Antarctic, PSCs remove nitrogen dioxide from the atmosphere, thus preventing formation of the chlorine reservoirs found at the middle latitudes. This is the most important step in the depletion process because it allows each Cl to pass through the cycle many times without being trapped. Thus, one Cl may destroy thousands of ozone molecules.

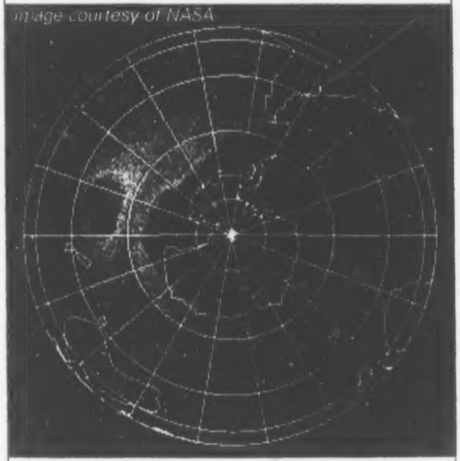


Image courtesy of NASA

Antarctic Ozone Hole, 10/1/94
By 1996, the average size of the antarctic ozone hole was 8.3 million square miles—an area the size of Canada, the U.S., and Mexico combined.

Ozone depletion in the Arctic is substantially less because PSCs form for shorter periods of time in that region than in the Antarctic. Even smaller quantities of ozone are currently being destroyed in the middle latitudes. Here, sulfuric acid may perform the same function as PSCs—release of chlorine from reservoirs and removal of nitrogen dioxide from the atmosphere. As a result, sulfate particles released into the atmosphere by a large volcanic eruption could trigger global ozone depletion in the future.

My Own Experiments

After understanding these processes, I set out to perform experiments to study the depletion of ozone. I worked out several possible experimental setups and decided that the best approach would be to build a reaction chamber in which to simulate the interaction of ozone and chlorine. However, problems soon arose. Despite my efforts, I failed to find any researchers in the area who were working on this subject and could provide me with advice. In addition, the equipment needed to simulate proper conditions—especially PSCs—was unavailable. I soon realized that an experiment of scientific merit would require the advanced facilities at a lab performing such research.

Eventually, I built a simple reaction chamber and performed a set of rather crude experiments. A local bottled water company provided the ozone, and I used sodium hypochlorite to produce chlorine. I allowed chlorine and ozone to react under UV light and measured final ozone concentrations. The results showed a minor decrease in the concentration of ozone.

Despite my inability to conduct an ideal experiment, this project taught me approaches to take when pursuing scientific projects as a high school student. Before tackling a scientific problem, determine whether you will be able to gain access to the necessary equipment. If advanced materials and facilities are not available, you may find it necessary to use a simple experimental setup to examine the scientific principles pertaining to the project. In most cases, a mentor can help you with this process. 🌐

A 12th grader at Taylor High School in Katy, Texas, ***Shaumo Sadhukhan*** *has continued his interest in environmental sciences. Last summer, at the Research Science Institute, he studied the possibility of using lichens as biological monitors of air pollution. Shaumo also participates in Academic Decathlon, Quiz Bowl, debate, and orchestra. You may reach him via e-mail: shaumo@ix.netcom.com*

Selected Resources:

Brodeur, P. (June 9, 1986). Annals of chemistry: In the face of doubt. *The New Yorker*, pp. 70–87.

Graedel, T.E. & Crutzen, P.J. (1995). *Atmosphere, climate, and change.* New York: Scientific American Library.

Toon, O.B. & Turco, R.P. (1991). Polar stratospheric clouds and ozone depletion. *Scientific American, 264*: 68–74.

For related Web-sites:
jhunix.hcf.jhu.edu/~setmentr/links_44.html

EXPLORING CAREER OPTIONS: GENETIC COUNSELING

Interview with Gloria Moy Petersen and Virgina Corson

by Carol Blackburn

If you have hay fever, you can go to an allergist; if a toothache, a dentist. But who could help you answer questions like these:

"My grandfather developed Alzheimer's disease. Is that hereditary? Will I get it, too?"

"Two of my aunts have breast cancer. Does that mean I'm at high risk for developing that or some other kind of cancer? Wait—even if someone can tell me, I'm not sure whether I want to know. Is there anyone I can talk to about this?"

These are tough questions. And tough in more ways than one: they involve not only specialized medical matters but also very personal concerns.

In this interview, we explore a career at the interface between the latest discoveries in genetic research and the needs of real patients. ***Gloria Petersen****, Ph.D., a medical geneticist and epidemiologist at The Johns Hopkins University School of Public Health, and* ***Virginia Corson****, M.A., a genetic counselor at The Johns Hopkins Hospital Prenatal Diagnostic Center, share their thoughts and insights about this challenging career field.*

◆

What is a genetic counselor?

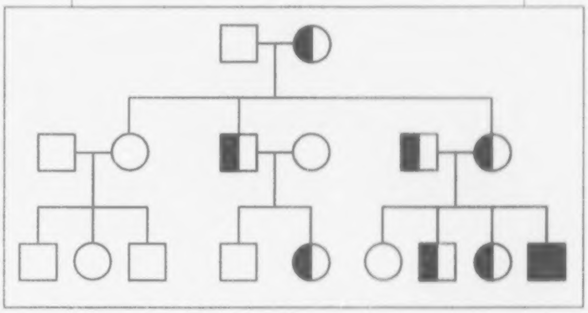
Virginia: We're health professionals trained in both medical genetics and counseling. We provide specialized information to patients, usually working in a clinical setting as a member of a team of physicians and medical geneticists.

Genetic counselors work with three kinds of patients: (1) couples at risk for having a child with a serious, genetically-based health problem; (2) parents of children with a genetic disorder; and (3) adults at risk for a genetically-linked, adult-onset condition like Alzheimer's disease or certain types of cancer.

Gloria: Ideally, such concerns should be handled by someone who has up-to-date information about the medical condition in question. The typical primary care practitioner can't do it; the human genetics field is changing so rapidly that it really takes a specialist to know what diagnostic tests are available and just how much information a patient can obtain from a given test. The molecular biological revolution has moved the field of genetic counseling into fast-forward.

What sort of training does one pursue to become a genetic counselor?

Virginia: The Master's level training usually takes two years and entails both course work and on-the-job experience. The course work includes classes in genetics, genetic disorders, and counseling skills, while the experiential component includes working under supervision with patients. There are about twenty genetic counseling Master's programs in the country.



Family Tree Genogram of a family carrying an autosomal recessive genetic defect (such as Tay-Sachs). Most family members are either non-carriers (open symbols) or healthy carriers (half-filled symbols). Only when both parents are carriers is there a 1-in-4 chance of producing a child with two copies of the defective gene (filled symbol) who will develop the disease.

You two do different sorts of genetic counseling. Virginia, why don't you describe your work first.

Virginia: I work in a Prenatal Diagnostic Center, where we counsel couples who are now or are considering becoming pregnant and who may be at risk for having a child with a genetic problem because of either the mother's age or a hereditary disorder in the mother's or father's families.

The conditions that bring prospective parents to the Center are serious ones. They often lead to severe mental retardation and/or early death. The film *Lorenzo's Oil* dramatized the story of one family whose son suffered from a life-threatening genetic defect. As in that story, it's sometimes possible to compensate for the defect.

However, many genetic diseases are still untreatable. Perhaps the best-known of these is Tay-Sachs disease, which is almost always fatal within two to three years. It's an autosomal recessive disease, meaning that a child must get two defective copies of the gene—one from each parent—in order to develop it. If a child gets only one defective gene, he or she will, like the parent, be a healthy *carrier*, spared the ill effects of the defective gene because of the presence of the other, normal gene.

Many couples at risk for Tay-Sachs come in for *carrier testing* before getting pregnant. Testing often brings the good news that one or both of them are not carriers. In the rare cases where both *are* carriers, they may face difficult choices. Some decide never to have children. Others become pregnant, then have prenatal testing to determine whether the fetus has two defective genes. Even when both parents are carriers, the fetus will be healthy in three out of four cases. So most of the time, I'm able to give prospective parents the wonderful news that their baby will not develop Tay-Sachs. Twenty-five years ago, all we could offer were odds. Many couples unwilling to chance 1-in-4 odds never had children. With genetic testing, most such couples can now enjoy their pregnancy without fear of what may lie ahead.

That's a wonderful reassurance to be able to give. Gloria, what does your work entail?

Gloria: I work with families at risk for genetically-linked adult-onset diseases. I'm currently working with Dr. Bert Vogelstein*, studying families that carry a gene for a rare type of colon cancer. While it accounts for only about 1% of all colon cancer in the country, the gene is a dominant one—a person need inherit only one copy in order to develop cancer—so in families that carry the gene, a lot of people are affected.

**An interview with oncologist Bert Vogelstein appeared in the May/June 1996 issue of* Imagine.

Each of us has, on average, five to ten genes that don't work properly. It's simply a matter of chance whether those genes end up causing problems for us or our children. Whenever we tell someone he or she has a gene known to be problematic, we always try to emphasize this point.

What might be a typical interaction with a patient or couple?

HUMAN GENETIC

Gloria: Generally, a person or couple is referred to a genetic counselor by a doctor. After inquiring about the family history of the condition in question, we explain the diagnostic tests available, describing the pros and cons of each. We help people explore their options and the consequences of each, working toward a decision based on their own personal and cultural beliefs. If they choose to have diagnostic testing, we see them again to explain the results and discuss the next steps they might take.

So someone who is unsure or undecided about being tested might come see you, to help them decide?

Gloria: Absolutely. We're here to help people understand their options. Certainly, in the case of a condition like Huntington's disease—where knowing your genetic status will make no clinical difference because nothing can be done to prevent or treat it—you may decide you're better off not knowing. In that situation, some people want to know their status, to allow them to plan for the future, but others prefer not to know.

It's often difficult for a person at risk for a genetic disease to find someone to talk to about his or her concerns. Family members may be at risk for the same condition. It can be a relief to find a sympathetic and knowledgeable person and be able to ask them questions openly.

Virginia: The psychological aspects of dealing with a genetic problem are very much a part of the concerns of a genetic counselor. We help individuals with questions like, "How am I coping with this? How is it affecting my relationship with my family and others?" Our work complements the more medical focus of the physician.

Your work involves helping people make decisions that are both emotionally and morally difficult. What professional guidelines exist to guide you?

Virginia: The hallmark of genetic counseling has been to be non-directive: to provide information but not to steer the decision-making. In prenatal genetic counseling, we *cannot* know people well enough to know what the best decision would be for them. We resist answering the question "What would *you* do?" because it's a recommendation we're truly not qualified to give.

Gloria: While prenatal genetic counseling will continue to be non-directive, genetic counseling for adult-onset diseases may become more directive as we learn more about them. As we find ways to help people lower the risk of developing such diseases, there may be a clear medical benefit to being tested.

What people would really like is gene replacement therapy—permanently "fixing" a gene—but that kind of genetic engineering is way down the road. Perhaps a decade from now, we'll be able to repair or replace some problematic genes, but that will open up *new* ethical debates.

It sounds as though genetic counseling will only continue to grow more challenging and complex.

Virginia: That was one of the things that appealed to me about it. The challenges will change over time, but the field will always have them. Already, we face decisions that are historically unprecedented; and as the technology continues to advance, the number and complexity of choices will only increase. I think the role for genetic counseling will be even more important as the decisions get tougher.

Do you find your work emotionally difficult?

Gloria: No, I don't. Having to deliver bad news is, of course, hard. But I always try to deliver hope as well, informing people of steps they can take to lower their risk. With early detection, many of my patients can have normal life spans.

Virginia: Even though I work with high-risk couples, in the majority of cases, I'm calling with positive, reassuring news, which is truly wonderful. Calling with bad news is the hardest thing I do; fortunately, I don't do it often.

Genetic counselors who work in pediatric clinics may have the most difficult job because they counsel families whose children already have problems. Their work is more long-term, seeing families through different stages of adjustment. And there are both triumphs and heartbreaks along that journey.

How did each of you come to this career?

Virginia: I was a biology major in college but wasn't interested in becoming a doctor or working in a lab. I actually heard about genetic counseling in a religion course that explored a number of ethical issues including those raised by the (at that time) very new area of genetic counseling. It sounded intriguing and appealing to me because of the combination of working with people and the science context. Mine is a classic success story of a liberal arts education: I took one religion course in college, and it led me to my career.

Gloria: I've been fascinated by genetics since I first encountered it—Mendel, peas, patterns of inheritance, all that great stuff. But I also loved anthropology, and my Ph.D. is actually in that field. As a grad student, I went to digs and studied bones, but I also learned a lot of genetics, now an important tool in anthropology. It wasn't until my final year in grad school that I was introduced to the idea that vulnerability to disease has a genetic component; but once I'd discovered that, I was hooked. Right after I finished my Ph.D., I made the transition to studying the genetics of disease, entering a training program in medical genetics and becoming a board-certified genetic counselor.

continued on page 17

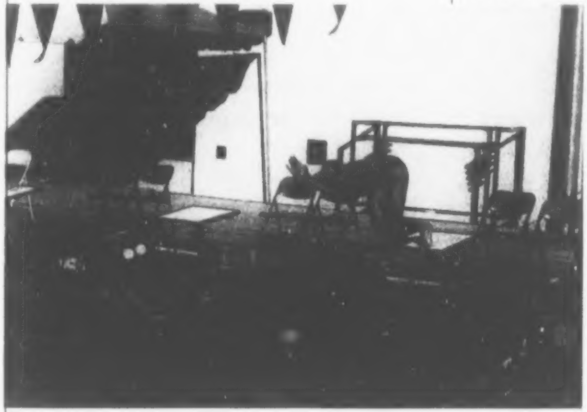
Erin at League Championships, freshman year

How I Transformed My Student Years by Competing in Sports

by Erin Moore

As a senior interviewer at Pomona College, I talk with high school seniors about what is important to them. Of all the topics we cover, the most interesting is often what these students have done **outside** *the classroom. Common extracurricular interests include student government, community service, music, and—probably the most popular—athletics. As we talk, I reflect on the role that sports have played in my own life.*

My involvement in sports began in first grade when I joined a youth soccer team. My primary motivation at that time was the fresh orange slices served at half time. Since then, my commitment to athletics and my accomplishments have increased. At age 7, I ran my first Bay-to-Breaker's race across San Francisco with my dad. At 12, I completed a half-marathon. As a college freshman, I achieved an All-American Honorable Mention in the 100- and 200-meter breaststroke at Division III Nationals. And the following summer, I participated in a night-swim from the Southern California coast to Catalina Island as a member of a world-record women's relay team.



On the block at Pomona, freshman year

When I was growing up, athletics strengthened my self-confidence and sense of personal identity. Many of us in honors classes were teased by other students, but my success in running helped me to win the respect of tougher kids at my junior high. By placing first and winning the turkey in my school's annual Turkey Trot running event, I gained confidence around students who had previously threatened to beat me up.

Sports also gave me increased confidence and comfort around males, a sense of ease that many of my non-athletic friends did not seem to share. Growing up without brothers, I began to feel comfortable with boys my own age only when I joined a coed swim team. I was able to gain their respect by competing against them, showing them I could push my body just as hard as they pushed theirs.

However, the most important benefits I have gained from fifteen years in athletics have to do not with social acceptance but with personal development. Participating in sports has taught me how to perform under pressure. Very few experiences prepared me for the stress of a key exam or presentation better than coping with the tension of being on the starting blocks at Nationals or hearing that the world record for a relay was in my hands. Many people shy away from competitive pressure, but persisting at such events has helped me overcome my own natural hesitation.

Sports have also given me an ability to accept defeat and an all important willingness to try again. There is always someone faster or better than you, always a team that outperforms your team. Through being cut from teams or beaten in competition, athletes learn to set personal goals rather than objectives that rely on the performance of others. Good athletes turn defeat into personal victory by learning from their mistakes and overcoming adversity. In the long run what really matters is participating in a sport, being a member of a team, and creating positive memories. My high school and college teammates became my best friends not only because we spent so much time together but also because we pushed our limits together and cheered each other on.

I believe that physical activity, whether competitive athletics or individual activity such as a walk in the park, should play a role in everyone's life. Some students react to academic pressure by abusing their bodies with alcohol, caffeine, or lack of sleep. Another abuse, often overlooked, is lack of regular exercise. Without a strong cardiovascular system, my mind cannot function at its full potential; I do not think as lucidly when my body feels sluggish and out of shape. Also, working out regularly and staying in shape has helped me to accept my body and to avoid the dieting syndrome to which many of my non-athletic friends have fallen victim.

At League Championships, junior year (center)

Don't tell yourself that you lack the natural ability to participate in sports. In many environments, sports such as running and swimming can accommodate a wide variety of skill levels. For example, I was pleased to be a member of Pomona Pitzer's cross-country team this year, with thirty women who ranged in experience from a runner who had competed at Nationals to a freshman who had never competed before.

Of course, balancing academics, athletics, and other activities is not easy. And relying on sports as the dominant source of one's self-confidence and self-image can have devastating consequences. During my freshman year, I lost my sense of priorities. I had chosen to attend an academics-focused Division III liberal arts college because I wanted to blend an excellent learning experience with competitive athletics. But I achieved personal bests so early in the swimming season that I became engrossed in my swimming. I even thought of giving up my goal of medical school to focus on moving up from the top sixteen to the top eight at Nationals.

But during the summer, I realized that pursuing a medical career was more important to me than improving my swimming times. I chose to give up varsity swimming with the 20+ hours a week it demanded. However, my sophomore year was then extremely difficult because I had lost my main source of confidence, my identity as an athlete.

After a year without competitive athletics, I truly missed the camaraderie of teammates, the confidence that comes with being in shape, and the thrill of competition. So I decided to join the cross-country team for my last two years of college, vowing to control my intensity. I have really enjoyed finding a balance point, keeping athletics in my life while maintaining academics and my ambition to become a physician as my first priority.

Now that my college athletic career is over (the cross-country season ended in October), I do not intend to stop enjoying physical exercise. Perhaps I will join an amateur master's team or just work out on my own. Competing in athletics has taught me many lessons, but I may decide I don't need to compete to gain satisfaction from training. I will continue running, swimming, and biking for the rest of my life. I hope that you, too, will find a place in your life for a sport you can enjoy and benefit from forever. ■

Erin Moore, a senior biology major at Pomona College, is applying to medical schools for admission next fall. Here she enjoys a Pomona study abroad program, in the Galapagos, Spring '96.

Exploring Career Options
continued from page 15

Do you have any final words for young people who might be interested in this work?

Gloria: It's a fascinating, exciting career in a constantly changing area. Not only do you learn about the astonishing discoveries being made daily in genetics, you also act as a conduit, bringing that information to people who can benefit from it. It's a really important profession—I don't know any other way to put it.

As biomedical researchers continue to study the genetic bases of diseases, more and more genes that cause or increase one's risk of developing a disease will be identified. The number of conditions for which genetic *vulnerability* can be assessed will explode in the next few decades. Tests will become available for conditions like cardiovascular disease and diabetes that affect large segments of the population.

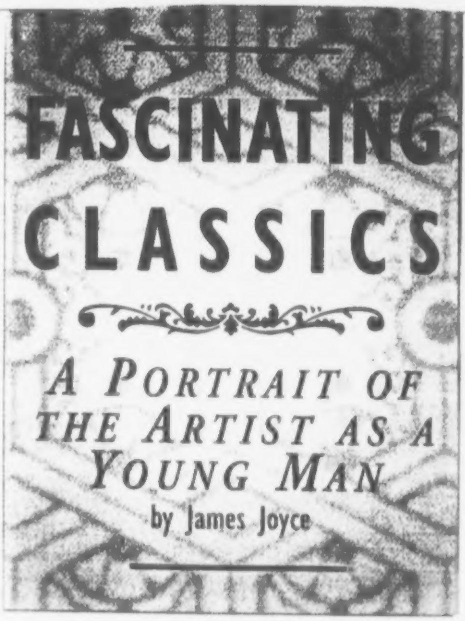
Professionally, our field is at a pivotal point. Patient education is becoming an increasingly important part of medicine. With the rapid pace of discovery in medical genetics, most doctors have neither the time nor the up-to-the-minute knowledge to explain genetic conditions to their patients. But it may take a while before the managed health care industry recognizes genetic counseling as an important component of modern medicine and routinely covers our services. Anyone interested in genetic counseling should reinvestigate the field's status when he or she is ready to apply to graduate school. ■

Selected Resources

Solving the puzzle: Careers in genetics, a booklet describing several career areas in genetics. The American Society of Human Genetics, 9650 Rockville Pike, Bethesda, MD 20814; (301) 571-1825.

Wexler, Alice (1995). *Mapping fate: A memoir of family, risk, and genetic research.* Berkeley: University of California Press.

Kitcher, Philip (1996). *The lives to come: The genetic revolution and human possibilities.* New York: Simon & Schuster.



Review by
Lesley Mackay & Charles Beckman

Lesley: Do you remember, Charles, how the world seemed when you were a child?

Charles: I don't remember my own early childhood all that clearly, but I have young sons, and I try to imagine how things appear to them.

Lesley: Joyce's 1916 modern classic transports the reader into a fictitious world in which childhood and then young adulthood are vividly depicted. The first section of James Joyce's *Portrait of the Artist as a Young Man* powerfully evokes the sensations of being a child of three or four. Here's how it begins:

> *Once upon a time and a very good time it was there was a moocow coming down along the road and this moocow that was coming down along the road met a nicens little boy named baby tuckoo...*
>
> *His father told him that story: his father looked at him through a glass: he had a hairy face.*

Charles: This beginning has a whimsical quality, of course. But Joyce is attempting a pioneering blend of form and content. His intention is to represent in a powerful, unmediated way what a young child sees, hears, feels, touches, and tastes. Ultimately, he shows the sensuous nature of childhood to be the basis of the adult capacity for artistry.

Lesley: Joyce's stream-of-consciousness technique allows him directly to represent perceptions, feelings, and thoughts. His style evolves subtly throughout the novel to demonstrate the maturing of his protagonist, Stephen Dedalus. The novel is like a transcript documenting the development of Stephen's emotional, intellectual, and artistic life.

Charles: Because of this, reading *Portrait* is an adventure, and a very modern one at that. Readers can easily absorb the information that is directly provided. However, they must also make inferences based on the many glimpses that are provided into the subconscious regions of Stephen's mind.

Major themes in the novel include Stephen's ambivalence about his family, his evolving interest in girls and women, and his fluctuating adherence to the Catholic faith. All of these are elaborated through the transcription of Stephen's intense, often imagistic, thoughts.

Lesley: Since this is a novel about a young man struggling to integrate what he notices, to develop a consciousness that is whole, all of the themes of the novel are related in some way. For example, in Stephen's mind, girls are connected with the powerful religious figure and icon, the Virgin Mary. Joyce shows this connection by having Stephen think of girls in images of ivory and gold that are used to describe Mary in Catholic prayers.

The strategy of using images to illustrate themes and to make connections among them pervades the novel, making it extremely poetic. In fact, Hugh Kenner, one of Joyce's most famous critics, referred to *Portrait* as "a three-hundred-page lyric."

Charles: I think the most memorable section of the novel is the one that comes after Stephen's infancy and that shows him first dealing with school. I didn't go to boarding school, and I am sure my parents would never have packed me off at age four or five. But I enjoyed Joyce's powerful depiction of Stephen in his first unfamiliar, challenging, and sometimes adversarial, social environment. Here's one passage from this section:

> *The wide playgrounds were swarming with boys. All were shouting and the prefects urged them on with strong cries. The evening air was pale and chilly and after every charge and thud of the footballers the greasy leather orb flew like a heavy bird through the grey light. He kept on the fringe of his line, out of sight of his prefect, out of the reach of the rude feet, feigning to run now and then. He felt his body small and weak amid the throng of players and his eyes were weak and watery. Rody Kickham was not like that: he would be captain of the third line all the fellows said.*

The brilliant image of the football as "a greasy leather orb" flying like "a heavy bird through the grey light" points to Stephen's already remarkable way with words.

Lesley: The passage also highlights Stephen's sense of alienation. He knows he is somehow different from his teammates, or at least from the best soccer players. Later, Stephen will lose the desire to fit in or

Classical Shades in Joyce's *Portrait*

A Portrait of the Artist as a Young Man begins with an epigraph from the story of Daedalus and Icarus in *Metamorphoses*, an acclaimed Latin poetic retelling of ancient Greek myths. *Metamorphoses* was written by the Italian writer Ovid at the beginning of the Christian era in 8 A.D. Ovid's focus was on metamorphoses, or transformations, undergone by the Greek gods and by legendary figures such as Daedalus, Icarus, Circe, Orpheus, and King Midas.

For his epigraph, Joyce took a short line from Ovid: "And he applies his mind to obscure arts." The line refers to Daedalus, an "old father, old artificer" with great artistic talent. Daedalus is best known for making waxen wings for himself and his son, Icarus, so that they could fly out of a labyrinth that Daedalus had created on the island of Crete. However, once free of the earth, Icarus soared, flying too close to the sun; his wings melted and he fell into the sea. His father arrived, safe but alone, on the island of Sicily.

In some Western literary works, Daedalus and Icarus have been transmuted into prototypes of the classical and the romantic artist, respectively: Daedalus embodies the notion of art as a craft demanding careful execution; his less mature, but possibly more brilliant son represents the idea of to excel at activities like sports. Instead he will cultivate a sense of himself as different from others by virtue of a superior, artistic sensibility.

Throughout the novel, Stephen is surrounded by passionate people with a variety of commitments: to Irish nationalism, the Catholic faith, social dominance, family love. But increasingly the only forces that move him are his amorous, yet ambivalent, feelings for women and his ambition to remove himself from his native environment and to become a writer. In this second aspect, as in many others, the novel reflects the experience of its author: Joyce lived in Zurich, in voluntary exile from his native Ireland, for his entire adult life.

JAMES JOYCE
A Portrait of the Artist as a Young Man

Charles: I think that you are on to something, Lesley, when you point out how fiery many characters in this novel are. Stephen's loquacious father, his zealous governess, his rage-prone teachers, and his competitive schoolmates all serve as perfect foils to Joyce's increasingly self-contained hero.

Stephen is hardly detached from girls, though. In fact, he becomes increasingly susceptible to women as the novel progresses. However, the novel sets up an opposition between available women, whom Stephen approaches, but does not respect, and inaccessible women, who serve as muse figures, inspiring his early writings as well as his private imaginings.

Here's one famous description of a figure Stephen spies at the beach:

> *A girl stood before him in midstream, alone and still, gazing out to sea. She seemed like one whom magic had changed into the likeness of a strange and beautiful seabird. Her long slender bare legs were delicate as a crane's and pure save where an emerald trail of seaweed had fashioned itself as a sign upon the flesh.*

Lesley: Stephen never meets up with this vision. But he does make brief visits to women who sell their bodies on the Dublin streets. The novel ends before its hero reconciles his conflicting ideas about women and desire. While at times he is overwhelmed by erotic ambition, at others he chastises himself with the full weight of the Catholic Church's disapproval of these thoughts. He writhes as he listens to a priest who had hit him as a child lecture on the agonies of hell. He considers becoming a priest.

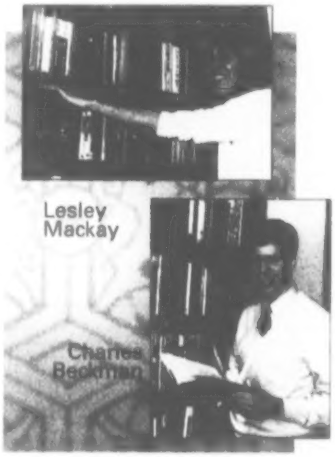
The priesthood offers Stephen an exit from the humdrum, sometimes sordid world that afflicts his often morbid imagination. However, by the end of the novel, he has experienced epiphanies, or moments of intense revelation, that point firmly toward another route of escape through the compelling life of the artist.

Critics have differed on the novel's success in portraying this solution to Stephen's quandaries. Some famous readers have even detected a fair amount of irony in Joyce's depiction of the sometimes pompous Stephen Dedalus. How seriously did Joyce take his young hero? Perhaps not perfectly seriously. But I think that the final section of the novel presents as convincing a resolution as one could expect for a hero so young.

Charles: I agree. It's valuable to remember that the novel is mainly about consciousness—and about the rich possibilities of a consciousness that is creative. Joyce may not have arrived at a resolution that can answer all of Stephen's adolescent pangs, philosophical questioning, restlessness, and ambition. But the artist's life does seem the proper destiny for Stephen—one that can incorporate both intense experience and the refining of experience through writing.

The novel ends on a most positive note with Stephen joyously exclaiming, "Welcome, O life! I go to encounter for the millionth time the reality of experience and to forge in the smithy of my soul the uncreated conscience of my race."

Lesley: Stephen's race is both the Irish race and the human race. He will leave Ireland in order to be able to write about it. And he will detach himself from others in order better to express the human condition in writing. The artistic quest he is adopting seems complex enough to satisfy even *his* restless, paradoxical nature. ■



Charles Beckman holds an advanced degree in writing from Johns Hopkins. He is Assistant Director of IAAY's Academic Programs. ***Lesley Mackay*** *is IAAY's staff writer.*

art as an exhilarating, potentially self-destructive means of transcendence.

In *A Portrait of the Artist as a Young Man*, Joyce names his protagonist Stephen Dedalus after the father in Ovid's pair. However, critics have argued that Stephen embodies the essential aspects of both Daedalus and Icarus: as a young artist and as a person, Stephen demonstrates an often uncomfortable mix of both conventional and iconoclastic tendencies.

Joyce's novel is largely devoted to addressing this critical question about artistry: How does one attain the drive and the ability to depart from the normal world without flying too close to the sun?

1996-97 series, Literature from Around the World:

Zora Neale Hurston, *Their Eyes Were Watching God*
Rudyard Kipling, *Kim*
Isabel Allende, *The House of the Spirits*
James Joyce, *A Portrait of the Artist as a Young Man*
☞ Alan Paton, *Cry, the Beloved Country*

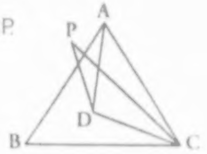
THE COACH'S CORNER

by Chengde Feng

Mr. Feng teaches mathematics at the Oklahoma School of Science and Mathematics (OSSM) and has coached many students who have competed successfully in mathematics contests in China and the U.S. In this column, Mr. Feng offers Imagine *readers questions designed to improve their problem-solving skills.*

1. Given that $\frac{x}{a} + \frac{y}{b} + \frac{z}{c} = 1$ and $\frac{a}{x} + \frac{b}{y} + \frac{c}{z} = 0$, find the value of $\frac{x^2}{a^2} + \frac{y^2}{b^2} + \frac{z^2}{c^2}$.

2. In the figure, Δ ABC is an equilateral triangle, DA = DC, CP = CA, and CD bisects $\angle$ BCP. Find the measure of $\angle$ P.



3. Find all the integers m such that $m^2 + m + 7$ is a perfect square.

4. Three teams, A, B, and C, play basketball games following the rule that the winner of a game between any two teams plays the third team in the next game. The final result is that Team A won 10 games, Team B won 12 games, and Team C won 14 games. If no teams tied, how many games did each of the three teams play?

5. 1997 students visited five cities last summer. Each student went to at least one city but no more than two cities. Prove that at least 134 students visited the same city/cities.

MATHEMATICAL PROBLEM SOLVING TECHNIQUES

Having radically accelerated his education, ***Alexander Saeed*** *(17) holds a B.A. in Biology/Psychology and an M.A. in Psychology from The Johns Hopkins University. He is now doing research in molecular biology under Nobel laureate Dr. Hamilton Smith.*

by Alexander Saeed

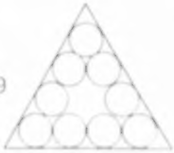
It's Magic!

This time, you have the chance to attempt something truly incredible. We'll start with a little background and some warm-up problems.

2	7	6
9	5	1
4	3	8

There are several kinds of *Magic Squares*; the kind I'm thinking of works this way. Make a 3x3 grid. In that grid, write the numbers from 1 to 9 so that the three numbers in each row, column, or central diagonal, when added, equal the sum of the three numbers in any other row, column, or central diagonal. You must use each number once and only once. In this sample solution, the magic number—the sum of each row, column, or central diagonal—is 15.

Can you solve a 4x4 *Magic Square*? How about a 5x5? Give it a try; you'll know when the answer is correct—just add up the numbers.

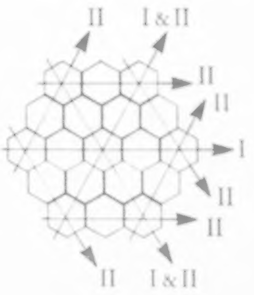


The world of magic shapes contains more than just squares. Let's try a *Magic Triangle*. Using each number from 1 to 9 exactly once, fill in this triangle so that the numbers on each of the triangle's sides add up to the same number.

Neurons warmed up? Ready for the challenge? Here we go! Can you make a *Magic Hexagon*?

Step I. Using each number from 1 to 19 exactly once, fill in all the little hexagons so that the sum of each straight row of five hexagons is the same.

Step II. Want a bigger challenge? In addition to making the sums of the five-hexagon rows equal, make the sum of each three-hexagon side equal as well.



Step III. For the biggest challenge, fill in the four-hexagon rows so that their sums are equal. The final result should be that the sum of each row of little hexagons in any direction is equal to the sum of every other row. Note: You may need to rescramble the numbers from Steps I and II in order to solve Step III, which has a unique solution.

This magic shape is much more complicated than the square and triangle, but it can be done. I'll reveal the solution in the May/June issue.

Why Take AP and SAT II Exams?

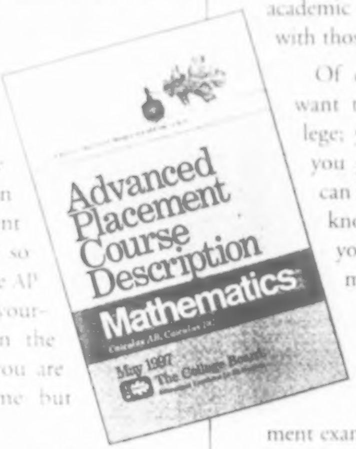
To Show Colleges—and Yourself—What You Know!

by Linda E. Brody, Ed.D.

This spring, over half a million students will take one or more Advanced Placement Program examinations. Vast numbers of college-bound students will also take one or more SAT II Subject Tests. Will you be among them?

Standardized tests have come under attack in recent years. This has led some colleges to make SATs optional, and AP tests have always been optional. So why burden yourself with studying for standardized achievement tests, risk doing poorly, and pay money to take tests that may not be required?

First of all, some colleges *do* require the SAT II; you don't want to limit your choice of colleges by being unprepared when they ask for achievement test results. Also, since so many students now take AP exams, you may find yourself less competitive in the admissions process if you are qualified to take some but choose not to do so.



If you carefully consider which tests to take and spend time preparing for them, you are likely to perform well. Good scores will be an asset to your application for college. Due to grade inflation, many students applying to selective colleges have excellent GPAs, and colleges may have difficulty evaluating the rigor of a particular high school's curriculum. Achievement test scores are one way for you to demonstate that you've learned a subject at a high level.

If you're homeschooled, it's especially important for you to take these tests so your performance can be compared to other students'. And if you're applying to college at a younger-than-typical age, good test scores can demonstrate that your subject knowledge and academic maturity are on a par with those of older applicants.

A Guide to the Advanced Placement Program
May 1997

Of course, you don't just want to be accepted to college; you also want to excel once you get there. Standardized tests can help you evaluate what you know about a subject, guiding your course selection and placement in college.

As for the cost of taking these tests, think about the cost of a college course. High scores on Advanced Placement exams can earn you college credits and save tuition money. And even if you don't plan to use the credits to accelerate completing your degree, appropriate placement will help assure that your college dollars are well spent on courses that maximize your learning.

So, as you plan for college, prepare to take as many standardized achievement tests as appropriate. Selective colleges typically require three SAT II Subject Tests; take more if you feel competent in more areas. And take as many AP courses and exams as possible based on your course schedule, school offerings, and ability. Be aware that you can take an AP exam even if you haven't taken the official AP course.

Take the exams whenever you are qualified to do so. Many students wait until senior year, but waiting may limit your options. For example, if you will take Biology only in 9th grade, and you're good in science, take the Biology exam then while the material is fresh in your mind. ❧

Information about SAT and AP tests is available from your school guidance counselor or on the World Wide Web: *www.collegeboard.org*

SAT
for both the
SAT I: Reasoning Test
and
SAT II: Subject Tests

ADVANCED PLACEMENT PROGRAM EXAMINATIONS

Two- or three-hour exams administered in May; multiple choice and free response. Assesses college-level coursework. Scores range from 1-5; colleges that award credit typically require a score of 4 or 5. To order course guides and old exams, call (609) 771-7243.

1997 AP Exams

Art: History of Art, Studio Art/General, Studio Art/Drawing. **Calculus** AB, BC. **Computer Science:** A, AB. **Economics:** Macroeconomics, Microeconomics. **English:** Language and Composition, Literature and Composition, International English Language. **Government and Politics:** U.S., Comparative. **History:** European, U.S. **Languages:** French Language, French Literature, German Language, Latin-Vergil, Latin Literature, Spanish Language, Spanish Literature. **Music Theory. Psychology. Science:** Biology, Chemistry, Physics B, Physics C-Mechanics, Physics C-Electricity and Magnetism. **Statistics.**

SAT II SUBJECT TESTS

One-hour exams, primarily multiple choice; testing dates throughout school year. Measures knowledge of high school coursework. Scores range from 200-800. You may register to take up to three exams on the same day.

1996-97 SAT II Exams

English: Writing, Literature, English Proficiency. **History:** American, World. **Languages:** Chinese Listening, French Reading, French Listening, German Reading, German Listening, Modern Hebrew, Italian, Japanese Listening, Latin, Spanish Reading, Spanish Listening. **Math:** I, IC, IIC. **Science:** Biology, Chemistry, Physics.

STUDENTS REVIEW

DARTMOUTH COLLEGE

College Review Series

This on-going series is intended to aid prospective college students in their search by offering insiders' views of selected colleges and universities, as expressed by current undergraduates or recent graduates who have high academic ability. Note that the number of reviewers is small. Consider their personal perspectives as only one component while you gather factual information and impressions from such other sources as college catalogues, site visits, talks with officials and students on campus, and the advice of your guidance counselor and teachers.

Dartmouth College

Our reviewers include thirteen students who major(ed) in Asian studies (2), biology (1), computer science (1), engineering (1), English (1), German (1), government (1), Hispanic literature (1), history (1), Italian literature (1), math (2), and religion (2). (The number of majors exceeds thirteen because two students have double majors.) Students' comments appear within quotation marks.

Quality of Academic Instruction for Undergraduates

Reviews of the quality of Dartmouth's education and faculty accessibility were very favorable. Dartmouth has an unusual academic calendar: the "D-Plan" is a year-round quarter system that gives students considerable flexibility in choosing which quarters to spend on campus. Students take only three courses per quarter, which fosters an in-depth learning experience.

"I think students here spend more time with professors and less time with TAs than do students at any other Ivy. Although it's a small college without the vast array of courses offered by larger universities, the quality of what they do teach is excellent. As an undergraduate, I had access to resources, like the electronic music studio, that would have been monopolized by grad students at a university. The large, open-stack library system is a big plus for browsers."

"Academic life at Dartmouth is focused on undergraduates. Many professors are distinguished in their fields, yet are accessible and dedicated to undergraduate education. Most classes are small; last term, I was in an intro class of 150 and two seminars of six and seven students."

"It's a very student-friendly college. Because of the D-Plan, courses are compact and intense. The opportunity to focus on only three subjects per quarter is a definite plus."

"I feel that Dartmouth is perhaps the best institution for personal attention and top-level education. I have discussed this with friends at other extremely competitive schools, and it seems to me that Dartmouth, Princeton, and Swarthmore rank highest for individual attention."

"Dartmouth's distribution requirements emphasize a broad-based curriculum. Students must take ten courses across eight subject areas: arts, literature, social analysis, historical or philosophical analysis, international study, quantitative science, natural science, and applied science. Students must also take three courses in world culture (one in European, one in American, and one in a non-Western culture). The distribution requirements can be enjoyably filled from a wide variety of courses."

"The non-Western course requirement gives students a perspective on the world as a community of complex cultures. Students must also take three terms of physical education, which I loved! I learned kung fu from a Shao Lin Master, learned to kayak white water rivers, and became an expert at racquetball. I would not have taken advantage of these opportunities without the phys ed requirement."

Social Life

Dartmouth offers a distinctive experience. Our reviewers highlight both its pros and cons.

"Dartmouth's location in a tiny college town in the New Hampshire countryside is either its best asset or worst liability, depending on whether you prefer a rural or an urban environment. There are no cool nightclubs, no funky ethnic neighborhoods with restaurants, no Metropolitan Museum or Broadway, but there are also no traffic jams, no smog, no crowded apartments, and very little crime. It's not a cultural wasteland—there are guest lecturers and performers, a small fine arts museum, an amazing bookstore, any number of music and drama groups, delightful cafes and restaurants, and a fantastic film society. However, Dartmouth's unique asset is the outdoor environment close at hand: the White Mountains nearby, the wonderful skiing, canoeing, hiking, and so on. Many Dartmouth students combine environmentalism and a love of sports with a desire for serious academic pursuits."

"Dartmouth is a residential community in the fullest sense, and I think most students would agree that the housing is outstanding. Most students live in campus housing, which includes dorms, frats, and affinity housing for students with shared extracurricular (e.g., Outing Club) or cultural (e.g., South Asian, Native American) interests."

"The majority of students take advantage of the D-Plan's flexibility and the college's many foreign exchange programs—nearly 70% of students study abroad. Because of this, two students are rarely together on campus for their entire Dartmouth careers. (The D-Plan is one reason the Greek system is strong: being in a frat or other social group gives you a steady group of friends and a place to go.) The terms when you are on campus with your entire class, notably sophomore summer, foster strong friendships with your classmates. Overall, I made great friends at Dartmouth."

"I personally found the D-Plan **great** *for me, but the disruption it creates is one of the number one complaints of students here. Friendships made in freshman year can be difficult to maintain, and few people are happy not to see their significant other for months at a time."*

"A lot of people have the wrong impression of Dartmouth—you know, **Animal House**, *where frat brothers sit around drinking 'til they do a technicolor yawn. But Dartmouth is so much more. Sure, there are frats and drinking, but there are lots of other activities—movies, dancing, tons of*

sports. But the best part is the friendships you make, however you spend your time."

"Dartmouth is not the most liberal school, but it's not the hotbed of conservatism it's reputed to be. The students who speak up tend to be politically conservative; there are liberals here too, but they make less of a ruckus. The majority of students tend to ignore them both and remain politically moderate or uninterested."

"The campus social life is dominated by a frat system that tends to foster a climate conducive to excessive drinking. The administration has made serious efforts to make the college more welcoming to women and minorities, but they sometimes meet resistance from alumni and a portion of the student body. Hanover can be a hard place for minority students to feel at home."

What Do You Like Least about Dartmouth?

The D-Plan and the location topped the list.

"I could not have asked for a more positive undergraduate experience in terms of my classwork and the opportunities afforded me by the D-Plan."

"The flexibility of the academic calendar. The D-Plan made it easy for me to do an internship in Boston during the winter when other college students were busy. Skiers can take winters off to compete, then go to school in the spring, summer, and fall. I liked the richness of the experiences (studying abroad, working, doing internships or volunteer work, climbing mountains) that I and other students brought back from our terms off campus; they complemented our academic education and sometimes made Dartmouth feel like a home base for an international community rather than an isolated town in New Hampshire. Best of all, I liked being able to walk out my door and go hiking or cross-country skiing."

"Dartmouth's size—not so small that you've met everyone and tried all the possibilities and gotten claustrophobic by the end, and not so large that you feel lost in a sea of people. It has the resources of a larger school, and those resources are available to undergraduates. It's a degree that opens doors in the real world."

"I love the fact that I am constantly encouraged by my professors to do my best. I love the fact that it's often sub-zero in the winter. It's hard to say what I like best about Dartmouth—there's no one thing. I love Dartmouth. It was the right choice for me."

What Do You Like Best about Dartmouth?

While some reviewers strongly affirmed that the school is no longer a bastion of male chauvinism, others felt that there's still room for improvement.

"The fact that the school still has a reputation for being chauvinistic. The social life has changed quite a bit in the past few years. Once, the typical student may have been a white frat boy who enjoyed skiing. This is no longer the case."

DARTMOUTH COLLEGE

Hanover, NH 03755
(603) 646-2875

- 4-year private coed university.
- Campus in a small, rural town.
- Full-time undergraduate enrollment 1996-97: 2,223 men; 2,058 women.
- Special features: The nation's oldest collegiate Outing Club. Over 40 off-campus study options.

"The only thing I would like to change is the frat-boy mentality that plagues so many people on campus. While I don't feel any pressure to join such groups, a lot of people are sucked into that way of thinking. The image of Dartmouth as a home for white, athletic, outdoorsy frat boys is not entirely untrue."

"I think it's worth noting that even people who find some portions of the student body annoying or offensive usually find a niche and have a very satisfying four years here."

"Of course I didn't like having to deal with sexism and intolerance; but these are issues that come up everywhere, and wrestling with them helps you become a stronger person. The real world includes conflict. The challenge is to know your own strength and to choose your battles. Each person has to decide if the positive aspects of Dartmouth outweigh the negative ones."

Who Would Be Most Compatible with the Academic and Social Atmosphere at Dartmouth?

"Outdoor people, scholar-athletes, environmentalists, people who want to be doctors because they want to help people, people who hate NYC and love Vermont, people who care less about fashion and more about practicality. PS. The winters are long and cold—you ***have*** *to love snow."*

"Someone who enjoys the outdoors, is excited by an intellectual discussion, can handle a fairly heavy workload, and wishes to engage his or her professors personally—in the classroom, in their offices, and on the racquetball court."

If You Had It to Do Over Again, Would You Go to Dartmouth?

While ten reviewers enthusiastically said yes, two were uncertain, and one has transferred to another school.

"Definitely! I cannot imagine a more enjoyable college experience anywhere. I would recommend it to anyone."

"I absolutely loved my four years at Dartmouth and could never say enough good about it. The esprit de corps among students, faculty, and alums and the tremendous attention undergraduates receive made it a superlative experience for me."

"Yes. I chose Dartmouth for its academic and natural environment. I found the academic quality to be everything I had hoped for and fell in love with the rural surroundings. I went in knowing full well that I would disagree with the attitudes of some of my fellow students, yet I was able to find a congenial niche with other people who shared my beliefs in tolerance and diversity. In the end, I learned a lot from the political conflicts that went on around me, and I probably turned out a better person because of it."

"I'm not sure. While I loved Dartmouth, my interests would have been better served at MIT."

As you try to find the college or university best suited to you, the views of Dartmouth presented above may be helpful. Keep in mind that these students might have had similar positive or negative experiences had they attended a different university. At any college, it is important to seek out challenging academic experiences and the best professors and to create a social life that fits your personal style. ■

Note: The students quoted in the College Review Series are expressing their own views, which are not necessarily those of JHU or IAAY.

Imagine is on the Web! Check out our home page:
jhunix.hcf.jhu.edu/~setmentr/imagine.html

CREATIVE MINDS

ImaGiNe...

Submit your creative work—brain teasers, short stories/essays/book reviews. We look forward to hearing from you.
Please write to *Imagine* • SET at IAAY • The Johns Hopkins University • Baltimore, MD 21218

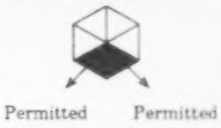
Fascinated by mazes and puzzles, ***Tim Boester*** *is also intrigued by roller coaster design. Tim is a junior at the University of Chicago, where he is studying physics and math.*

YES, ANOTHER PUZZLE

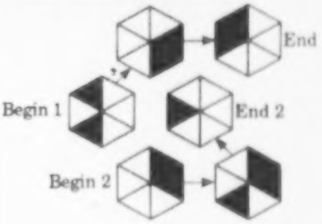
by Tim Boester

We missed Tim and his masterful puzzles so much that we went back to his file and found another variation.

EXAMPLE ONE



EXAMPLE TWO



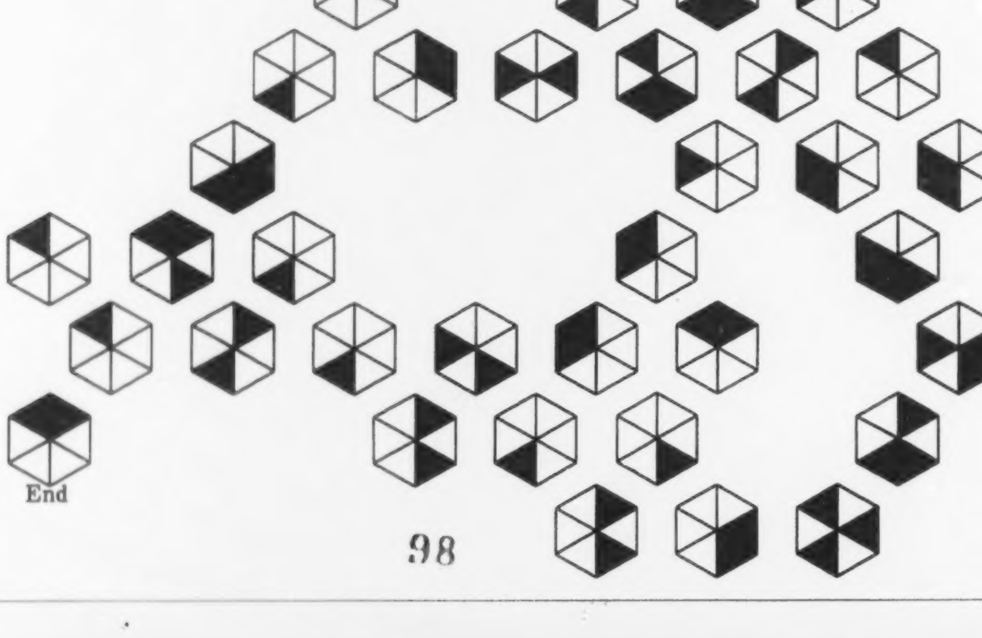
DIRECTIONS

First, the easy part:

- This puzzle involves two players who take turns jumping one hexagon at a time.
- Each player begins at a different hexagon marked *Begin*.
- Players **are** permitted to move onto hexagons previously occupied by the other player or by themselves, but both players cannot simultaneously occupy the same hexagon.
- Each player must reach a different hexagon marked *End*.
- Since the two players alternate moves, they must arrive at the hexagons marked *End* in successive moves.

Now, the hard part:

- The filled sector(s) on the hexagon occupied by *one player* indicates the direction(s) in which the *other player* is permitted to move.
- **Example 1:** If one player was on this hexagon, the filled sectors indicate that the other player would be permitted to move southeast or southwest, taking north as the top of the page.
- **Example 2** provides a several-move illustration. Player #1 begins at the hexagon marked *Begin 1*. The filled sectors on Player #2's hexagon (*Begin 2*) indicate that Player #1 may move either NE or E. After moving one hexagon NE, Player #1 stands on a hexagon that permits Player #2 to move either E or SE. This process continues, with both players landing on hexagons marked *End* in their second moves.



VOLUME [illegible] • NUMBER 5

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May/June 1997

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Published by the Johns Hopkins University Press for the JHU Institute for the Academic Advancement of Youth

IAAY

Spotlight On

CONNECTING WITH COMPUTER TECHNOLOGY

Students can use their computers to take writing, science and math courses through IAAY's Distance Learning Program.

Twenty years ago the head of a leading computer company publicly stated, "There is no reason anyone would want a computer at home." He simply couldn't envision the powerful ways computers would change our lives.

The Internet, one of the most dramatic advances in computer technology, has expanded our options to learn, to communicate, and to create. In this issue, you'll learn about using the Web to locate an abundance of resources, conduct research, preview and apply to colleges, and communicate at home and abroad.

If you've never created a Web site, use our guide to get started. If you've learned the basics and enjoy collaboration, consider entering ThinkQuest. And if you thrive on competition, set your sights on the USA Computing Olympiad—or the Westinghouse Science Talent Search, where this year's top winner invented a microchip-manufacturing technology and another finalist wrote a program that enhances the ability of computers to learn.

More than ever before, we are connected to people around the world, and our endeavors touch people we may never meet. As our writers make clear, connecting with computer technology can transform us—both as individuals and as a global society.

ANNOUNCING VOLUME 5
FOCUS TOPICS FOR 1997–1998

- Biological Sciences & Medicine
- Literature, Language, & Linguistics
- Public Service & Politics
- Mathematical Pursuits
- Multimedia Communications

Moving On . . .

After four years as editor of *Imagine*, Susan Hellerman is leaving us. One of the founders of this periodical, Susan has worked tirelessly to undangle modifiers, relocate misplaced commas, disengage jumbled sentences, and clarify meaning. *Imagine* has always been complimented on its quality, and Susan deserves many thanks for turning numerous hunks of carbon into diamonds.

Recently we read a wonderful description of the editorial process, written by James Thurber about working with *New Yorker* editor Harold Ross. It reminded us of Susan; any of our writers might notice the resemblance.

> *Having a manuscript under Ross's scrutiny was like putting your car in the hands of a skilled mechanic, not an automotive engineer with a bachelor of science degree, but a guy who knows what makes a motor go, and sputter, and wheeze, and sometimes come to a dead stop; a man with an ear for the faintest body squeak as well as the loudest engine rattle. When you first gazed, appalled, upon an uncorrected proof of one of your stories or articles, each margin had a thicket of queries and complaints—one writer got a hundred and forty-four on one profile. It was as though you beheld the works of your car spread all over the garage floor, and the job of getting the thing together again and making it work seemed impossible. Then you realized that Ross was trying to make your Model T or old Stutz Bearcat into a Cadillac or Rolls-Royce. He was at work with the tools of his unflagging perfectionism, and, after an exchange of growls or snarls, you set to work to join him in his enterprise.*
>
> —James Thurber, *The Years with Ross*

Best wishes, Susan!

☛All Web sites mentioned in this issue are available on *Imagine*'s Web links page: http://jhunix.hcf.jhu.edu/~setmentr/imagine.html

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Imagine...
*Opportunities and Resources for Academically Talented Youth**

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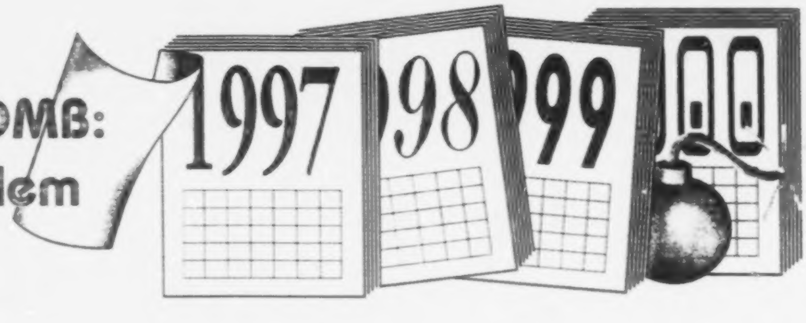
COMPUTER TIME BOMB:
The Year 2000 Problem



by Eileen Ptak

As the next millennium approaches, the computer industry is bracing for impending disaster. Unless corrections are made, computer systems all over the world will malfunction at the stroke of midnight as the year 2000 begins.

This crisis could affect almost everyone, because computers impact nearly every aspect of our lives. Governments, hospitals, schools, and businesses all rely on computer systems to process data, store records, and perform calculations. Even our VCRs and digital clocks rely on computer chips.

Roots and Scope of the Problem

The so-called Year 2000 Problem is rooted in the way computers store dates. The convention of the six-digit date format—MMDDYY, which allows only two digits for the year—began in the 1950s. In those days, computers took up entire rooms and were programmed using thin, envelope-sized punch cards. One card could store only eighty characters; to save space, as well as money and time, programmers adopted the abbreviated date format.

As a result, computers were programmed to read 98 as 1998, and 99 as 1999. So, when a computer's calendar rolls over to 00, it will register not as 2000 but as 1900. And the computer will no longer perform date-related calculations correctly.

A long-distance telephone call lasting from one minute before midnight until one minute after might rack up over 100 years of charges. Air traffic control computers might ground planes, because it would appear that they hadn't been serviced for nearly a century. ATM and credit cards might seem to have expired long ago. Even elevators and missiles, which have the date hard-coded into a silicon chip, might shut down due to an apparently extensive lapse in servicing.

Fixing the Code

The solution to all these potential problems seems simple: just add the other two digits into all the programs. But *finding* all the dates in a computer program is the first obstacle. Dates can appear any number of times and at any place in a computer program, so every line must be checked. The sheer volume of code is overwhelming. Many small companies have as many as 100 thousand lines of code, while some Fortune 500 companies have over 200 million lines.

Prepackaged software can scan through programs to locate areas where date codes probably exist, but a lot of the code still has to be checked and corrected manually. There is no "silver bullet," no quick and easy solution.

Several methods can be used to fix the code. The most tedious but most thorough method is called *expansion.* Programmers must examine each line of code and replace all two-digit year-dates with four digits.

A much easier way to repair the code is known as *windowing.* A few lines are added to the beginning of a program that allow it to interpret all dates falling within the 50–99 window as 1950–1999, and dates within the 00–49 window as 2000–2049. This method spares the programmer from having to scan through the lines of code and fix each date. But this isn't the best solution for many programs. Any program that uses birth dates, for example, can't use that windowing fix: the birth date of a hospital patient born in 1940 would register as 2040. Also, windowing fixes will have to be changed again before 2050, since the program would register that date as 1950.

As if scanning and correcting all the code weren't daunting enough, there's another problem: a lot of the code is difficult to decipher. Many programmers in the '60s and '70s did not have standard methods of documenting their code, and some didn't document at all. Many never thought their programs would be changed by anyone else.

In addition, much of the software that needs fixing was written in COBOL, a language that hasn't been used extensively for nearly twenty years. Rewriting these old programs in a modern computer language would be expensive and time consuming. So companies are paying top dollar to hire the limited number of COBOL programmers still available.

Larger Problems: Time ...

Adding the two missing digits seems complicated enough, but other factors compound this global computer crisis. "This is not a technology problem," insists Art Brody, a senior manager at KPMG, an international consulting firm that helps companies bring their computer systems into year 2000 compliance. "Fixing the code is the *easy* part. The crisis lies in the lack of time and the amount of money needed to solve the problem."

Before programmers can start fixing code, all the software and hardware in a company has to be assessed. "Your strategy might include one or more of the following: renovate the current code, replace it with a new system, or completely retire the hardware and software," Brody notes. Estimates are that the assessment process, management of the project, and testing represent 50-70 percent of the total effort required to ensure year 2000 compliance. Most companies are trying to finish by December 1998, because they may need an entire year to test their systems in a fully operational environment.

continued on page 7

PANNING FOR GOLD ON THE WORLD WIDE WEB

by Carol Blackburn

The Web's vast, constantly changing contents include rags, riches, and everything in between. But when you're seriously searching—not just surfing—for information, is the Web *useful?* Very, if you know where to look. Already loaded with gold, it's acquiring more every day. And it can also lead you to valuable off-line resources.

Prospecting on Your Own

If you have a fairly well-defined topic in mind, a Web search engine may be the best place to start. Using this tool will yield an amazing number of possible links. Some will be "hits," while many will be of dubious quality or not what you had in mind. For example, a Yahoo search on "Rocky Mountain spotted fever" (RMSF) yielded 62,650 matches. Many of the first 60 or so looked promising, but after that, the odds of encountering a useful link dropped quickly. The remainder were related to "spotted fever," "fever," "Rocky Mountain," and so on.

Hits about RMSF included sites developed by universities, public health departments, and commercial healthcare information providers; local newspaper articles about people with RMSF; a company that sells the microorganism that causes RMSF; and the homepage of a microbiology professor. One of the misses was an essay entitled "Spotted Fever," about the author's passion for her Dalmatian puppy. (At least, that's what Yahoo *said.* When I clicked on the link, eager to read about a wriggling little scamp, I found myself instead at an online review of Aerosmith's latest album.)

Currently, AltaVista is the most extensive search engine:
altavista.digital.com/

Yahoo, a searchable directory, is also very useful:
www.yahoo.com/

Let the Experts Do the Sifting

Even when you use search engines, the Web holds more treasure than you're likely to discover on your own. One rewarding gateway to online riches on a given subject is a list of links that has been prepared by an expert in that field.

A consortium of scholars at top universities and research institutions around the world has organized one such resource, the *W3 Virtual Library.* Each of its gateways connects you to relevant databases, search engines, online publications, research centers, academic departments, and museums. This superb collection runs from "Aboriginal Studies" to "Zoos," with such topics as "Tibetan Studies" and "Whale Watching" along the way.

For more Web-based treasure than you can imagine, check out the W3 Virtual Library:
www.w3.org/pub/DataSources/bySubject/
Overview.html

For discipline-specific links to some sites of more interest to novices, see the University of Michigan's *Internet Public Library:*
ipl.si.umich.edu/ref/

Online journals and news services can also be helpful. Some, like *Scientific American,* freely offer information at their Web site; in fact, because the online articles include hypertext links, they are even better resources than the hard copies. Other publications, hoping to lure subscribers, offer little online beyond a table of contents and a few teasers. In any case, you can identify, if not access, many resources via journal Web sites.

The Library of Congress maintains links to many online publications:
lcweb.loc.gov/global/ncp/pertitle.html

Yahoo lists all sorts of online media:
www.yahoo.com/News_and_Media/

Surveying Other Resources

The Web also provides access to vast reserves outside the Web environment, like the Library of Congress card catalogue. Online card catalogues enable you to *search* a library's book holdings, although they do not yet *display* or provide a link to the contents of the book (even if those contents happen to be online somewhere else*). Such sites do not give you access to *periodical* search engines like Medline.

Browse the card catalogue to see what's available at the Library of Congress:
lcweb.loc.gov/catalog/

Use UC-Berkeley's Libweb for links to libraries around the world:
sunsite.berkeley.edu/Libweb/

A Web search can supplement and shorten, but usually not replace, a visit to the library. Leave enough time to track down the off-line resources the Web has helped you identify. Remember, it always takes longer than you think.

**Although many complete book texts are available on the Web, card catalogues do not include hypertext links to online texts.*

POLISHING YOUR PRODUCT

When you're ready to write your paper, online resources can serve you again. Many universities have set up online writing labs, or OWLs, with grammar guides and hints to help you structure research papers and improve your writing. Some OWLs allow you to submit your work to a writing tutor, although first priority goes to students at that school.

The University of Michigan hosts an OWL that accepts outside submissions:
www.lsa.umich.edu/ecb/OWL/owl.html

RPI maintains lists of links to other OWLs:
www.rpi.edu/dept/llc/writecenter/web/net-writing.html

SELECTED RESOURCES

Online tutorial:
www.prenhall.com/~bookbind/pubbooks/rodrigues/

Rodrigues, D. (1997). *The research paper and the World Wide Web.* Upper Saddle River, New Jersey: Prentice Hall.

Morris, E. (1996). *The book lover's guide to the Internet.* New York: Fawcett Columbine.

And just for fun:
Hafner, K. and Lyon, M. (1996). *Where wizards stay up late: The origins of the Internet.* New York: Simon & Schuster.

ALL THAT GLITTERS …

Evaluating the Quality of Web Documents

by Elizabeth Kirk and Lesley Mackay

While its great promise is undeniable, the Web can pose problems for the researcher. Its abundant resources offer not only true finds but also fool's gold: out of date, biased, incomplete, and inaccurate "information." How can you make the most of your search for high quality resources on the Web? Elizabeth Kirk, library instruction coordinator at the Milton S. Eisenhower Library of The Johns Hopkins University, offers some sound advice.

Conducting research on the Web is not like conducting research at a library. Each resource you find in a library has passed through at least one human filter before being selected. Trained librarians have personally screened, reviewed, and chosen the books. Research articles available in academic libraries have survived peer review to be included in journals; the journals themselves have been indexed by scholarly or professional organizations convinced of their merit.

But no such filtering takes place with the search engines that index the Web. There, a single request can produce references to a mountainous mishmash of information. Excellent resources may be called up with dubious ones. Because the Web is accessible to anyone who wants to add a document, sorting through Web documents can be a demanding and surreal activity. So the Web lends itself to the warning *Caveat lector*: let the reader beware. Given the sheer volume of available resources, how can you assess the quality of Web documents?

Apply all the standards you would use in judging the merit of any printed work.

- Look for a bibliography and other attributions that demonstrate the author's familiarity with related, established sources.
- Consider the author's mastery of relevant theories and techniques. Look for a clear explanation of research methods and for details that are verifiable.
- If the topic is time sensitive, check that the information is still current. Look for a tag showing when the Web document was last updated.

Apply additional standards that pertain specifically to Web documents.

Search Engines and Directories: How was the list of documents generated? To evaluate what you have called up from the Web, you need to understand the method used by the particular search engine to conduct the search. For example, *AltaVista* is a search engine with the largest, most inclusive indices and little editorial control. *Yahoo!* is not a search engine, but a hierarchically arranged subject index that has been edited. Helpful hints:

- To increase your chances of calling up relevant documents, learn to shape and limit your search by using *Boolean operators* such as **and**, **plus**, **minus**, as well as other words and symbols. Each search engine has its own specific features.
- To learn more about search engines, directories, and defining a Web search, see *How to Search the Web: A Guide to Search Tools*, by Terry A. Gray: **issfw.palomar.edu/Library/TGSEARCH.HTM**

Authorship: Who wrote the document? As with any other resource, you are concerned about the writer's credentials and reputation in the relevant field. To assess the professional background of a Web document author:

- Check to see if the document includes the author's credentials or provides links to a homepage with information about the author.
- Look up the author's name in catalogues and electronic databases to review his or her past publications.
- Find out if another document written by an author you trust contains a link to the document you are evaluating.
- Use e-mail to communicate directly with the author.

Publishing domain: Who is offering the document? First, look for the category at the end of the domain portion of the URL; for example, **edu** indicates educational institutions; **gov**, federal government; **org**, nonprofit organizations; and **net** and **com**, commercial sources. (You won't want to judge a document solely on its domain, however; remember that a commercial source may offer valuable information.) Next, note the name that precedes these letters; does that organization itself have credentials or authority related to your subject? Other hints:

- What is the source of the document? Along with the URL, check headers and footers for indications of an organization's official Web site.
- Does the document reside in an individual's homepage? Documents from personal locations may be interesting and valuable, but again, you'll want to consider the author's credentials.

Develop your powers of discrimination.

As you become more knowledgeable about a subject, you can also use your own judgment to consider whether a Web document seems sound. Do the fundamental concepts echo those in other texts you have read? Does the intellectual framework seem solid? Is the document reasonably well written, and does the tone seem appropriate to the topic? At first you may be uncomfortable making such judgments, especially if you are just beginning to learn about the topic. Keep at it; the more you persevere, the more confidence you will gain.

Evaluating documents requires the ability to sift through information with an analytical eye, to discriminate between a scholar's solid research and someone else's personal opinion. You acquire this ability the same way you hone any other skill—with practice. Developing and using critical standards to assess all kinds of resources—both on and off the Web—is essential to becoming a smart, sophisticated learner.

For more suggestions on making the most of Internet technology, see the March 1997 issue of **Scientific American**, *also at* ***www.sciam.com/0397issue/0397***

Create Your Own Web Page:

Getting Started

by Eileen Ptak

Long before I opened an Internet account, I had my Web page planned out. I wanted links to *The X-Files*, my high school and college, and the interactive frog-dissection page I had found. I looked forward not only to exploring the graphic creativity the Web allowed, but also to learning HTML, which is "programming lite." As soon as I had my UNIX account, I started creating my link to the world.

HTML (HyperText Mark-up Language) is the vocabulary the Web understands. It's not difficult or techy; in fact, it's not much different from assigning qualities like bold or italics to text in your word-processing program. With a handful of HTML commands, you can easily create a Web page.

Ready to jump into the world of Web programming? All you need are an Internet provider*, a browser (like Netscape or Mosaic), and a text editor. A text editor only understands ASCII, the basic set of keyboard characters; it doesn't allow formatting such as font choice or bold. You can use your word-processing program as a text editor by saving files in ASCII format. If your program can't save in this format, use the text editor (like Notepad or Simple Edit) that comes with your computer.

All HTML commands are sandwiched between two < > brackets, and most commands come in pairs: a "begin" tag and an "end" tag. Some tags are rebels and loners; they don't hang out with a closing tag. We'll encounter them later.

All right, enough background. Open a new page in your text editor and type <HTML>. (When you've completed your page, remember to type </HTML>.)

Next, create a title for your Web page. Every page needs a title; browsers use it to create bookmarks. Surround your title with the begin and end commands, <TITLE> and </TITLE>. The <BODY> tag comes next; it indicates the main text of your page.

These are the three main tags that give structure to your Web page. Every page should follow this pattern:

```
<HTML>
<TITLE>My Web Page</TITLE>
<BODY>
Contents of your page
</BODY>
</HTML>
```

Now comes the fun part: the content of your Web page. Before you start typing, remember that Web browsers ignore word processing commands like Enter/Return, Tab, Center, and Bold. You can control the appearance of your page only by using HTML commands.

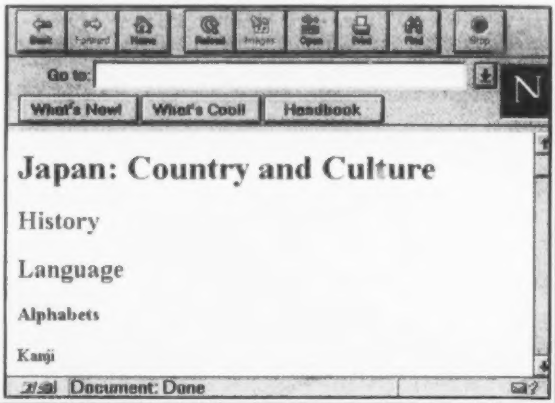
To begin a new paragraph, use the <P> tag. The closing tag, </P>, is optional. Some browsers allow you to use multiple <P>s to spread out text on the page, but others collapse the extra <P>s down to one. A more reliable way to add space between paragraphs is by using the break tag, <BR>, which actually interrupts the text and continues it on the next line. This tag is especially useful for lines of poetry or addresses.

After you've written all your text, you can really jazz it up. Some HTML commands give you control over the appearance of your text. You may have seen <B> and <I> commands, representing bold and italics. Technically, these are not HTML commands, but Netscape extensions. If you are concerned that other browsers will not be able to read your specifications, use the HTML codes <EM>, for emphasis, and <STRONG>. Most browsers display text tagged <EM> as italics and <STRONG> as bold.

The next step is to design your page's layout. <CENTER> is a very useful tag that can be used to control words, paragraphs, and images. It is a Netscape extension and doesn't have an HTML equivalent. I use this command frequently, even though some browsers ignore it.

Add graphic interest to your page with grey lines known as horizontal rules; the <HR> command does not need a closing tag. HTML also has several tags for headings. Just as you would imagine, headings are large, bold ... well, headings, which nicely subdivide your text. They vary in size: <H1> is the largest, <H6> the smallest. If you were using headings to subdivide a page on Japan, for example, you might organize it like this:

```
<H1>Japan: Country and Culture</H1>
<H2>History</H2>
<H2>Language</H2>
<H3>Alphabets</H3>
<H4>Kanji</H4>
```



Japan: Country and Culture

History

Language

Alphabets

Kanji

---

*Note: Unless you have free Internet access through an educational institution, you'll need to check with your provider about the costs of storing a Web page.

In this example, the subheads "History" and "Language" are equal in size to each other and smaller than the main <H1> header. "Alphabets" is a subhead of "Language," and "Kanji" is a subhead of "Alphabets."

HTML can also create ordered (numbered) or unordered (bulleted) lists. To create an ordered list, surround the items with the commands <OL> and </OL>; for an unordered list, use <UL> and </UL>. Within these two tags, precede each item with <LI>, "list item." Here's an example of a bulleted list:

```
<H3>My Favorite Bands</H3>
<UL>
<LI>REM
<LI>311
<LI>Metallica
</UL>
```

Links, which enable you to jump from one site to another, are the best feature of the Web. The HTML tag for linking to other sites is slightly more complicated than the commands we've seen so far. Each link includes both an anchor—the words you'll click on to jump to another site—and the URL (Uniform Resource Locator, or Web address), which tells your browser where to jump. The link tag is <A HREF>, which means anchor: Hypertext reference, and </A>.

To create a link, you need to specify the URL within the first part of the tag; ex: <A HREF="http://www.yahoo.com">. Then, type your anchor words, and follow with the closing tag. Your finished link should look something like this:

<A HREF="http://www.yahoo.com">Go to Yahoo!</A>.

Now you have the basics to create your own Web page. Once you've created your document, save it in ASCII format. Remember to include the extension .html on a Mac or .htm on an IBM. To see exactly how your Web page will look to the rest of the world, click on File in your browser, select Open File, and check it out. Once you've finished creating your document, upload it to your Internet provider with an FTP (File Transfer Protocol) program. Note: If you are using an IBM, you should rename your file using the .html extension. (If you leave it as .htm, people who type .html will not be able to access your page. So it's safer to comply with the four-character format.)

Congratulations! Now anyone anywhere on the Web can access your page.

Once you're familiar with HTML, you'll want to learn more. Tables can help you format your page. Graphics, color, sound, and video can really spruce up your document. For more tricks and tags, check out the source code of other people's pages by looking under View on your browser's menu bar.

See how easy HTML programming is? On to Pascal!

Quick Guide

Begin document	<HTML> ... </HTML>
Title of page	<TITLE> ... </TITLE>
Contents of page	<BODY> ... </BODY>
Begin a paragraph	<P>
Break a line	<BR>
Emphasis (italics)	<EM> ... </EM>
Strong (bold)	<STRONG> ... </STRONG>
Center text or image	<CENTER> ... </CENTER>
Horizontal rule	<HR>
Header (largest)	<H1> ... </H1>
Header (smallest)	<H6> ... </H6>
Ordered list	<OL> ... </OL>
Unordered list	<UL> ... </UL>
List item	<LI> ... </LI>
Link (anchor)	<A HREF> ... </A>

Selected Resources

Lemay, L. (1995). *Teach Yourself Web Publishing with HTML in 14 Days.* Indianapolis: Sams.net Publishing.

A Beginner's Guide to HTML
www.ncsa.uiuc.edu/General/Internet/WWW/HTMLPrimer.html

HTML Quick Reference
www.cc.ukans.edu/info/HTML_quick.html

The Year 2000 Problem, continued from page 3

They have to know not only that *their* systems are year 2000 compliant but also that all the *other* systems they interface with are compliant.

... and Money

The Gartner Group, an information technology analysis firm in New York, estimates that fixing the date problem worldwide will cost $300–$600 billion. The price of bringing all U.S. companies and organizations into compliance has been roughly calculated at $276 billion, almost half the worldwide estimate.

An organization's solution could be as simple as replacing old software with new date-compliant software, or as complex as replacing entire computer networks—but it will be expensive. "I am working with an international Wall Street investment banking firm," Brody says, "and their cost may be as much as $100 million." *$100 million* for only one among the millions of companies that will need to fix their computers! But surprisingly, some people are predicting that the largest percentage of the total global expense will involve litigation and damages resulting from date-related errors.

Many companies are reluctant to address the Year 2000 Problem because it requires their making a huge financial investment to do no more than maintain current productivity. Some are waiting in vain for a magic solution. The Gartner Group estimates that nearly 50 percent of companies will not be completely prepared by the year 2000. Many will go bankrupt due to a lack of compliance, lawsuits, or failure to recoup costs.

So, to stay on top of this costly chaos, you might want to become a programmer now—and a lawyer in the year 2000....

Selected Resources

To read more about this complex problem:

www.year2000.com/cgi-bin/y2k/year2000.cgi

www.yahoo.com/Computers_and_Internet/Year_2000_Problem/

The ThinkQuest competition is designed to encourage students to expand their communication and computer skills while they develop educational tools that imaginatively exploit the Internet's multiple possibilities.

How many times have you sat in class thinking, "If *I* were the teacher, I could make this class a lot more interesting"? Well, here's your chance, and you don't have to wait until you're an adult. Consider participating in ThinkQuest, which awards scholarships to precollege students aged 12-18 who design innovative, educational Web sites.

To encourage creative collaboration, ThinkQuest requires that all submissions be group efforts. Teams of two or three students, working with one to three coaches, choose a topic they believe has educational merit. By the end of January, each team must submit a formal proposal in one of five categories: Science & Math, Art & Literature, Social Sciences, Sports & Health, or Interdisciplinary. If the project is approved, the team has until the end of July to complete its entry.

ThinkQuest is serious about encouraging students to create exciting Web-based educational tools. The site chosen "Best Entry in Contest" nets each student team member a $25,000 college scholarship. Top entries within each category also earn prizes; each student team member receives a scholarship worth $15,000 for first place, $12,000 for second, $9,000 for third, $6,000 for fourth, and $3,000 for fifth place. Coaches and sponsoring schools also receive prizes.

EDU STOCK

I'd Like to Teach the World ...

In 1996, some ThinkQuest contestants focused on material that might be covered in a high school curriculum. Three New Jersey high school students placed first in Arts & Literature for their site, *MusicNet*, which includes an interactive encyclopedia of music. Another team of New Jersey high schoolers captured the top award in Social Sciences for *Anatomy of a Murder: A Trip through Our Justice System*.

Other teams took the opportunity to venture outside the usual high school fare. "Best Entry in Contest" went to *EduStock*, a stock market tutorial created by three Maryland high school students. In addition to offering information on how to choose a good stock, this site includes a stock market simulation using real-time accurate stock data. And three high school students from Hawaii won the "Outstanding Educational Achievement" award for *Design: Paradise*, which allows users to explore the relationship between industry, environment, and population by participating in an urban development simulation.

In the true spirit of online learning, some 1996 teams were made up of members who lived in different states and collaborated in cyberspace to create their Web site. *Runner's Oasis*, which won the top Sports & Health award, was designed by high school students who live in New Hampshire, Vermont, and New York: and the "Outstanding Technical Achievement" award, for *From the Ground Up: A Guide to C++*, went to a team composed of two high school students from Virginia and one from Alaska. Their computer-programming tutorial keeps track of when you've skipped ahead, and tries to adapt what it does to make sure you don't miss anything important.

Think Quest

Teaching and Learning, Internet-Style

Not all the 1996 top prizes were won by high schoolers. First place in Math & Science went to a team of middle school students from Virginia. Their site, *The Fractory: An Interactive Tool for Creating and Exploring Fractals*, includes an online make-your-own-fractals component, as well as links to other fractal fanatics on the Web.

design Paradise

The Interdisciplinary category opened the door to all sorts of unusual educational enterprises. Another Virginia/Alaska team of high schoolers earned first place for *The Online POV-Ray Tutorial*, which utilizes a sophisticated 3-D image-rendering program to enable the user to create visual art. POV-Ray generates images by mathematically modeling light rays as they interact with objects. The team members were so excited by the artistic and design possibilities of POV-Ray that they decided to design this Web site to help others take advantage of its creative potential. Their tutorial's links to graphics libraries of scenes, objects, and textures guide the user in designing imaginary tableaus and landscapes, which POV-Ray then translates into image files. If you've always wished you could paint or sculpt, but have never mastered the skills, this site might just help you unleash the artist within.

Designed to be Used

Respecting all the ingenuity and hard work that went into creating these and other exciting submissions, the sponsors want the student sites to be *used*. So they have made all the entries available for free at ThinkQuest's Web site. Go there to be educated and entertained, and maybe you'll be inspired to create your own ThinkQuest entry. What would *you* like to teach the world?

—*Carol Blackburn*

ThinkQuest was devised by Advanced Network & Services, a non-profit organization devoted to expanding the educational use of the Internet. Sponsors include Microsoft, IBM, Netscape, and other Web-wise corporations.

Visit the ThinkQuest Web site:
io.advanced.org/thinkquest/

Program the USA Computing Olympiad into Your Future

by Russ Cox

Every summer, many of my friends go to sports camps or to academic programs like CTY. If you're a high school student interested in computer programming, set your sights on the USA Computing Olympiad (USACO) Training Camp, held annually in June. Only the nation's top dozen or so precollege programmers are invited to participate in this all-expense-paid week of learning and fun. And with the invitation comes the chance to be chosen to represent the U.S. at the International Olympiad in Informatics (IOI).

Fall and Winter Championships

In 1997, the USACO added two new contests for individual students—and the option of receiving your problems and submitting your solutions via the Internet. The new fall and winter options take place in November and January, and are open to all precollege students. You can practice with the USACO challenges of the week (COWs), available on-line.

Qualifying Round

If you don't participate in the Fall and Winter Championships, you may begin in mid-February with the Qualifying Round. This week-long contest offers four or five problems meant to challenge you and help you decide if you are ready for the next round. Here's a sample 1996 problem:

The factorial of an integer *n*, written *n!*, is the product of all the integers from 1 to *n* inclusive. The factorial quickly becomes very large; 13! is too large to store in a 32-bit integer on most computers, and 70! is too large for a floating-point variable. Your task is to find the rightmost non-zero digit of *n!*. For example, 5! = 1 x 2 x 3 x 4 x 5 = 120, so the rightmost non-zero digit of 5! is 2. Also, 7! = 1 x 2 x 3 x 4 x 5 x 6 x 7 = 5040, so the rightmost non-zero digit of 7! is 4. Your program will not be presented with *n* greater than 1000.

After you write your solutions, your teacher or local contest coordinator tests them. Solutions to this round must run in one minute. If you successfully complete enough problems, you move on to the next round.

National Championship

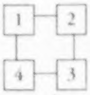
It took me three years to pass the Qualifying Round and advance to the Competition Round, now known as the National Championship. Here, you get your first taste of conditions at the International Olympiad level. The previous round allowed you a week to mull over the problems; this round, like the IOI, speeds the pace by requiring you to solve three problems in a mere five hours. Solutions must run in under 10 seconds on a 100 MHz Pentium. Those who know about the old UUCP network that preceded the Internet will appreciate this sample problem:

Farmer John's cows like to keep in touch via email so they have created a network of cowputers so they can intercowmunicate. These machines route email so that if there exists a sequence of cowputers a1, a2, ..., a(n) such that a1 is connected to a2, a2 is connected to a3, and so on, then a1 and a(n) can send email to one another.

Unfortunately, a cow will occasionally step on a cowputer or Farmer John will drive over it, and the machine will stop working. This means that the cowputer can no longer route email, so connections to and from that cowputer are no longer usable.

Two of the most cowmunicative cows are pondering the minimum number of these accidents that can occur before they can no longer use their two favorite cowputers to send email to each other. Write a program to calculate this minimal value for them, and to calculate a set of machines that corresponds to this minimum.

The input given to the program was a textual description of what cowputers connected to what other cowputers in the network. Suppose you had a network that looked like this:



To stop cowmunication between cowputers 1 and 3, you need to remove cowputer 2 as well as cowputer 4, resulting in a minimum of two cowputers needed to forestall cowmunications.

USACO Training Camp and Final Round

Out of several hundred students who enter the previous round, one is chosen National Champion, and 12 to 16 are invited to compete in the Final Round held at the USACO Training Camp. Selections are based not only on how well your programs work but also on programming style and organization.

The Training Camp, hosted by the University of Wisconsin-Parkside (hence the cow references), offers just the right mix of education and enjoyment. A morning lecture and lab are followed by a leisurely lunch. After another cycle of lecture and lab in the afternoon, everyone goes outside, usually to play ultimate frisbee. Even the coaches participate. Evenings include a fun activity—something as nerdy as a business simulation game, or as simple as ice cream, bowling, or pool.

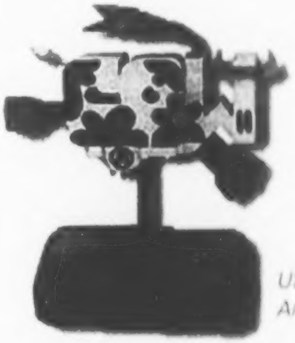
Two five-hour, three-problem competitions constitute the Final Round. Based on the results, as well as other information gathered during the week, the coaches choose four students to form the U.S. team to the IOI.

International Olympiad in Informatics

Similar in spirit to the USACO Training Camp, but on a much larger scale, the IOI includes two days of five-hour competitions. The rest of the week, team members tour cities, learn about the host country's culture, and enjoy meeting other computer jocks from around the world.

Ultimately, that's what these contests are all about: getting to know other people who share your interests and abilities. When Pierre de Coubertin reestablished

continued on next page



USACO Americow

THE GLOBAL INFORMATION INFRASTRUCTURE

Could We Use Computer Technology to Heal the World?

by Sheila Kumar

The Web is becoming an integral part of family, school, and business life. Chat rooms, email, and surfing the Net are common terms and, for many of us, daily experiences. Our technical ability to connect people around the globe via the Internet can be a huge asset to our society, if we use the opportunity wisely.

In February 1995, representatives from the leading industrial nations gathered in Brussels, Belgium, to hold a G7 Information and Communication Ministerial Roundtable. Government delegates and business leaders debated how to unite the world by creating interconnecting telecommunications networks—a technological concept proposed by the U.S. and referred to as the Global Information Infrastructure (GII).

Although that conference was limited to adults, several attending business representatives had a great idea: why not hold a similar conference for students? They thought that, since young people are the ones who will use the GII and provide leadership in the future, they should be involved in the planning process now. They also felt that the younger generation might have more creative ideas about the potential applications of this technology.

Arranging the GII Junior Summit

Supporters in Japan and the U.S. began to plan the GII Junior Summit '95. They invited students 12 to 18 years old to submit essays via the Internet about current social problems and how the GII could help alleviate them. Three hundred entrants would be chosen to take part in an Online Forum from August 1995 to February 1996. Forty award winners would be invited to Tokyo for a three-day conference that fall.

While taking some classes at Stanford, I learned about the Junior Summit because the Stanford Program on International and Cross-Cultural Education was one of its sponsors. It's not often that I feel I can have a strong voice in the world. The opportunity to connect with students around the globe and discuss the Internet, one of the major advances in society today, was too tempting to miss.

I had lived through the L.A. riots of '92 and heard about the problems wracking Bosnia and Rwanda. So I decided to write my essay on racial tensions and the part they play in history. I wrote that most prejudices arise out of ignorance and fear. And I suggested that, if we used the Internet to make people more aware of each other, perhaps hatred could be reduced.

Chatting Online

I was invited to take part in the Junior Summit Online Forum, which was divided into four groups: Environment, War and Peace, Communication, and Education. I joined the War and Peace group. For five months, we emailed each other and discussed such topics as the assassination of Israeli Prime Minister Yitzhak Rabin and the shooting at Dunblane School in Scotland. We also held Web chats with guests, such as Israeli and Palestinian schoolchildren.

During our discussions, we often came to the same conclusion: if people understood each other better, perhaps many of the causes of war could be avoided. The Internet already provides a way to reduce ignorance; it enables us to communicate with other people and learn about their lives, cultures, and hopes. The proposed infrastructure would improve the Internet and provide stronger links to even more areas of the globe. Building world peace through better understanding could become the most important advantage of the GII.

At the end of the Online Forum, each group wrote a "white paper" in which we summarized our discussions. Two kids from my group read the War and Peace white paper at a meeting of United Nations representatives.

Thinking Young, Thinking Ahead

We are the first generation to grow up with the Internet as part of our everyday lives. Since we're not afraid to try new things, we bring a fresh perspective to discussions about the proposed GII.

Interacting with peers around the world for five months, I learned what a valuable tool the Internet can be. The most important result of my involvement is the feeling that, even though I'm not yet an adult, I have taken part in exploring something that could affect the world's future.

Now a 10th grader at Harvard-Westlake School in Los Angeles, ***Sheila Kumar*** *is active in school sports, including soccer and track and field. She also participates in the USA Mathematical Talent Search and speech competitions. Sheila enjoys family visits to India.*

To read the Online Forum white papers: **www.jrsummit.org**

USACO, continued from page 9

the Olympic Games a century ago, he hoped that "international youth [would] draw from it the love of peace and respect for life." The USACO and IOI produce the same result. You have fun, you take part in friendly competition, you learn a lot about your own country and other countries—and the world becomes a little smaller.

Russ Cox *won a gold medal at IOI '95 and was a USACO Finalist in '95 and '96. Born the same year as the Apple Macintosh, he is now a senior at Delbarton School in Morristown, New Jersey, where he edits the newspaper, sings in the choir, and manages the baseball team.*

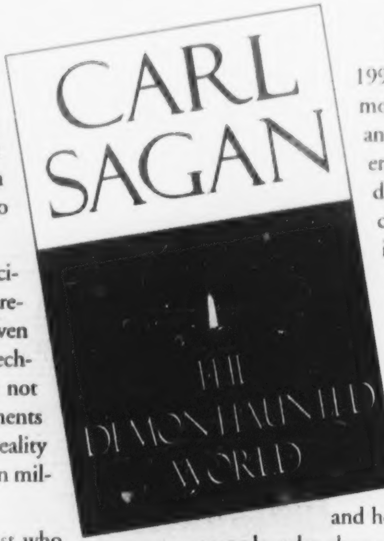
The 1997 USACO National Championship will be held April 9. The 1997 IOI will take place November 28–December 7 in Cape Town, South Africa. The USACO is sponsored by USENIX. For more information: usaco.uwp.edu

Darkness and Light

BOOK REVIEW

by Alejandro Jenkins

Legend has it that the entire population of Iceland converted to Christianity on New Year's Eve, 999, out of fear that the world would come to an end with the arrival of a quadruple-digit calendar year. Now, as the Western world approaches the year 2000, we are observing a fresh outburst of millennialism, which has led not only to increased religious fervor but also to such ghastly events as the recent mass suicide at Rancho Santa Fe.



As we have seen, encounters between modern science and ancient superstition can produce unpredictable, even deadly consequences. Paradoxically, even as modern society grows increasingly dependent on technology, most people—even well-educated ones—are not scientifically literate enough to make informed judgments about the world in which they live. Faced with a reality they find difficult to understand, many seek answers in millennialism and the mysticism associated with it.

The late Carl Sagan, a distinguished astrophysicist who earned worldwide celebrity through his eloquent efforts to bring modern science to the lay public, explored this complex problem in his final book, *The Demon-Haunted World: Science as a Candle in the Dark* (Random House, 1996). In uncompromising terms, he expresses concern over the current juxtaposition of technological accomplishment and widespread scientific illiteracy:

> *"We might get away with it for a while, but sooner or later this combustible mixture of ignorance and power is going to blow up in our faces....*
>
> *"I worry that, especially as the Millennium edges nearer, pseudo-science and superstition will seem year by year more tempting, the siren song of unreason more sonorous and attractive. Where have we heard it before? Whenever our ethnic or national prejudices are aroused, in times of scarcity ... then habits of thought familiar from ages past reach for the controls.*
>
> *"The candle flame gutters. Its little pool of light trembles. Darkness gathers. The demons begin to stir."*

Sagan's book is an absolute joy to read. His style is engaging and eloquent, his arguments clear and convincing. Over the course of more than 400 pages, Sagan develops a coherent case for scientific thought and against its numerous modern and not-so-modern contenders. His masterful use of anecdotes from his own life and work adds an emotional dimension to his rigorous intellectual argument. The result is a book readers can feel in the marrow of their bones.

The book starts by analyzing the psychological motivations behind unscientific thought: our fear of the unknown, and our desire to believe in the possibility of making things true by wishing them so. As Sagan explains, it was in our evolutionary interest that children be fearful of "things that go bump in the night," so they would not stray from their parents after dark. Powerless before this primeval, nameless terror, we desperately seek explanations, and true ones are not easy to come by. The enormous temptation to believe something simply to gain some sense of control leads inevitably to unreason.

With scientific skepticism and a wry sense of humor, Sagan explores the vast realm of the irrational. Providing many illuminating criticisms and parallels, the author deals with such topics as astrology, faith healing, channeling, telepathy, ESP, the Roswell incident, and the 1995 "alien autopsy." He compares, for example, modern descriptions of alien abduction with ancient European demon stories, noting that modern aliens seem to be as obsessed with our reproductive systems as traditional demons were centuries ago. The structure of the visitations is identical; only the origin attributed to the "visitors" has changed.

Faced with the demons engendered by fear and gullibility, Sagan confidently wields the candle of reason. He devotes a special chapter to instructing the reader on how to address claims scientifically: how to remain both open minded and skeptical, how to analyze the validity of evidence and testimonies, and how to ask the hard questions. (He wonders, for example, why channelers never provide us with information that is verifiable and unavailable by other means.)

The scope of the book is by no means limited to refuting the paranormal. The author is also concerned with instances of shoddy science such as recovered memories and facilitated communication. He is deeply concerned with the increasingly lower standards of scientific education in schools, and the overtly hostile attitude towards science frequently displayed by the media and politicians.

Sagan emphasizes how irrational thought often leads to needless suffering. He reminds us of the horrors wrought by advocates of unsound ideas not only in the distant past but also in this century. Whenever unreason becomes widespread—whether during medieval witch-hunts or under totalitarian regimes—we face the dangers of increased cruelty, intolerance, and even social collapse.

Despite its cautionary message, *The Demon-Haunted World* is a vibrantly inspiring work. Sagan's words ring with his hope for the ultimate triumph of reason over unreason: the victory of light over darkness. He describes how science allows us to understand reality and put it to the service of human well-being. He emphasizes the importance of rational discourse in a healthy democracy. The way to counter fear, Sagan asserts, is *not* to raise our children with hedonism, superstition, and consumerism, as we have been doing for years, but rather to inspire them with science and a sense of hope. As he puts it: "In the demon-haunted world that we inhabit by virtue of being human, this may be all that stands between us and the enveloping darkness." ■

A native of Costa Rica, ***Alejandro Jenkins*** *recently graduated first in his class from his country's math/science magnet high school. He plans to enter Harvard this fall. (This photo was taken on the Hopkins campus when Alejandro attended a CTY summer program in 1993.)*

WESTINGHOUSE SCIENCE TALENT SEARCH '97

A Chance to Shine

Have you ever considered inventing a technology? Proving a new theorum? Identifying a novel gene? Do these goals sound extraordinarily ambitious for students still in high school? They are, of course, but this year over 1,600 seniors from across the country submitted such projects to the 56th Annual Westinghouse Science Talent Search, the nation's most prestigious precollege science competition.

From a pool of 300 semifinalists, 40 finalists were invited to attend the five-day Science Talent Institute in Washington, D.C., where they were wined, dined, and exhaustively quizzed by top scientists. This year, as always, their projects ran the gamut from algebra to zoology.

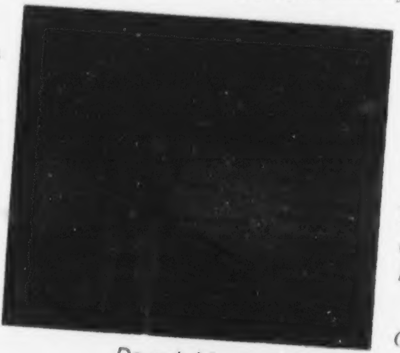
After a public exhibition of the 40 projects, the judges announced the ten top winners, who received national recognition and acclaim along with substantial college scholarships. First, second, and third place scholarships are worth $40,000, $30,000, and $20,000, respectively. Fourth through sixth place winners each receive awards worth $15,000; seventh through tenth place winners, $10,000; and the remaining 30 finalists, $1,000.

Genius at Work

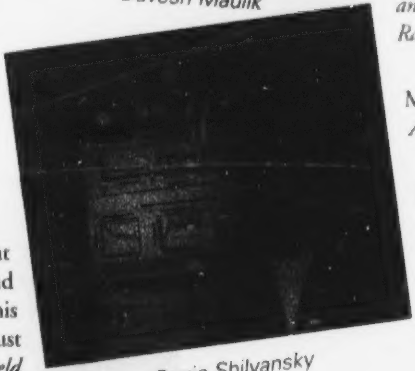
It just wouldn't be the Westinghouse without at least one young Edison whose fertile mind dreamt up a never-before-seen device. But this year's first prize winner, **Adam Cohen**, didn't just invent a new technology; he invented a new *field* of technology. His brainchild, *near-field photolithography*, will facilitate the large-scale production of nanoscale patterns on microchips.

Photolithography, the use of light to etch patterns onto surfaces, is already an important process in microchip manufacture; but Silicon Valley CEOs are always looking for ways to etch even smaller patterns onto their chips. Adam envisioned a way to do just that. And he was so convinced of the viability of his idea that he spent months building a scanning tunneling microscope (STM) in his bedroom, using electronic components from Radio Shack, Legos, and bungee cords. He then invented an "electrochemical paintbrush" to allow the STM to paint copper dots as small as 60 nanometers in diameter.

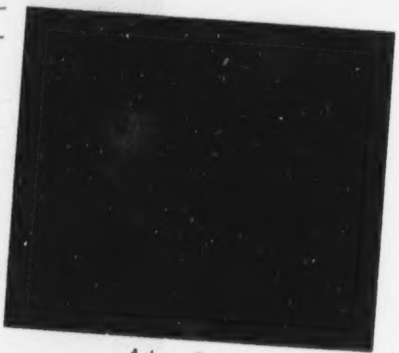
Adam's inventions have enormous commercial potential. Within a few years, you'll probably be using faster and more powerful microchips made possible by this young Westinghouse winner!



Davesh Maulik



Carrie Shilyansky



Adam Cohen

And the Winners Are . . .

1. **Adam Ezra Cohen**, age 17, New York, New York. *Near-Field Photolithography: A New Nanoscale Patterning Technique Using a Scanning Tunneling Microscope and a Novel Electrochemical Paintbrush.*

2. **Carrie Shilyansky**, 15, San Marino, California. *Modulation of a Learning Pathway by Information Encoded during Habituation of a Gill Withdrawal Reflex in Aplysia californica.*

3. **Nicholas Eriksson**, 18, Missoula, Montana. *q-Series, Elliptic Curves, and Odd Values of the Partition Function.*

4. **Davesh Maulik**, 18, Roslyn, New York. *Polynomial Automorphisms of Splitting Fields.*

5. **Emily Beth Levy**, 17, North Miami Beach, Florida. *Principal Component Analysis of the Effects of Brain Imagery Techniques on the Achievements of Dyslexic Students: A Five-Year Study.*

6. **Dev Edward Kumar**, 17, Dallas, Texas. *Cheap and Reliable Radio-Frequency Devices: Design and Construction of a Real-Time, High-Bandwidth, Radio-Frequency Power-Added Efficiency Monitor.*

7. **Ann Seiferle-Valencia**, 17, Farmington, New Mexico. *Chacoan Anasazi, The Death of a Culture: A Four-Year Study.*

8. **Dylan Micah Schwindt**, 18, Cortez, Colorado. *Wood Sourcing Study of Utah Juniper (Juniperus osteosperma) Trees Growing in Sand Canyon, Southwestern Colorado.*

9. **Rose Payyapilli**, 17, Brooklyn, New York. *Novel Regulation of Platelet Activation: Discovery of a Plasma Inhibitory Factor (PIF) and a New Platelet Inhibitory Receptor (PIR).*

10. **Whitney Paige Bowe**, 17, Lawrence, New York. *Symbiosis: The Inducement of a Symbiotic Relationship between Cassiopea xamachana and Chlorella.*

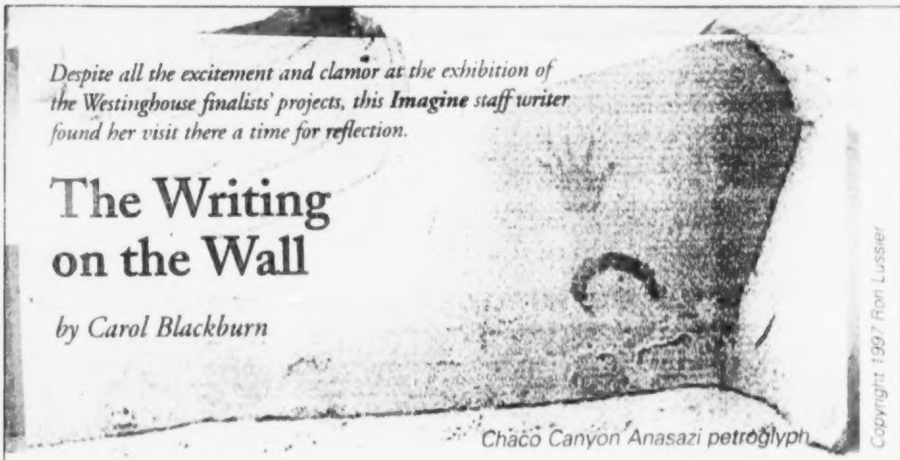
As these project titles suggest, the scientific talent showcased during this exhibition covers the full spectrum: mathematics, engineering, and physics; chemistry and biology; and the social sciences. The Westinghouse encourages America's next generation of researchers to show the world what they can do, and provides an informative and inspirational glimpse of where science and technology are headed. ■

The competition is sponsored by the Westinghouse Foundation and Science Service. For information on how to enter, write or call: Science Service, 1719 N Street, N.W., Washington, DC 20036; (202) 785-2255. For abstracts of 1997 finalists' projects, see the Web site: www.westinghouse.com/cmty/h_sci.htm

Despite all the excitement and clamor at the exhibition of the Westinghouse finalists' projects, this ***Imagine*** *staff writer found her visit there a time for reflection.*

The Writing on the Wall

by Carol Blackburn



Chaco Canyon Anasazi petroglyph

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Ghosts. In the animated atmosphere of the National Academy of Sciences' auditorium, amidst the flashing bulbs of press cameras and the buzz of conversations about ground-breaking scientific innovations, ghosts seem out of place. But they are here, looking over our shoulders.

They have come from New Mexico, accompanying Westinghouse finalist **Ann Seiferle-Valencia**, who studied the demise of the Native American Anasazi culture. Five years ago, on a field trip to the Chaco Canyon, Ann stared into the blank gaze of the windows of abandoned houses and wondered what had happened to the people who inhabited them. Why had their civilization ended?

Ancient Mysteries

Chaco Canyon, first inhabited in 6000 BC, was home to the Anasazi from about 700 to 1200 AD. Around 1000 AD, the Anasazi suddenly began a period of building large houses. A few hundred years later, just as suddenly, they disappeared—leaving behind one of the great mysteries of North American archaeology.

"People have this stereotype that all Native Americans lived in harmony with nature," observes Ann. "That idyllic notion is consoling; it distances us from them and their fate. But my research indicates that the problems that plagued them were the same ones we face today: overpopulation, depletion of natural resources that can only be renewed slowly, and failure to make cultural changes that address impending shortages."

Ann performed mathematical analyses of previously published raw data from many archaeological researchers. "I would read papers, and the authors would mention a few artifacts, then offer their speculations—and I would say, 'Where's the math? Where are your models of what was happening?' So many parameters that *can* be modeled and analyzed mathematically weren't. So I decided to do it."

Working alone, without help from a teacher or mentor, Ann used published data to model population dynamics. She detected a rapid increase in mortality due to malnutrition at the same time that the community's building projects depleted the area of wood. Over a period of only about fifty years, the life of the Chacoan Anasazi became insupportable. "They must have seen they were having trouble feeding themselves. But instead of making pragmatic changes such as trying to limit their population or modify their lifestyle, they appear instead to have developed more elaborate religious rituals, praying for more rain and better harvests."

Ann Seiferle-Valencia

Reading the Signs

Potential threats to the well-being of *our own* communities attracted the attention of several other Westinghouse finalists. After learning that use of antibiotics has spurred the evolution of antibiotic-resistant bacteria, **Merri Moken**, of Morristown, New Jersey, wondered whether the use of disinfectants might be having a similar effect. She found that household disinfectants cause bacteria to express a gene that makes them resistant to a wide range of antibiotics. "Amazingly, the expression of the gene in disinfectant-exposed bacteria is even greater than it is in antibiotic-exposed bacteria! *E. coli* bacteria exposed to one disinfectant became 100% resistant to an antibiotic to which they had never been exposed. We think we are making our environment safer by disinfecting it, but we are only pushing microbes to become stronger, to evolve into strains that can resist our lethal weapons. It's a basic law of nature."

Another finalist, **William Blodgett**, of Wellington, Florida, was excited when he learned about bioremediation, the process of using living organisms to clean up environmental messes. He was particularly intrigued by the prospect that microorganisms could convert discarded or spilled petroleum products into less harmful biological compounds. But William was also wary: would bioremediation end up having unanticipated and harmful consequences? To check, he simulated an oil dump, added bioremediating microorganisms, then looked to see whether mutagenic compounds were formed. "I'm not sure whether to say I was lucky or unlucky, but I did succeed in finding what I was looking for: a mutagen, and a water-soluble one at that—one that could contaminate local groundwater unless we take precautions to prevent that from happening."

The Future is Not Set

But will we take appropriate precautions? Or will we, like the Anasazi, pray for rain and hope for the best?

Ann Seiferle-Valencia's research has prompted her to reflect upon such questions. "Some people have looked at my research and said, 'It's depressing to see how quickly a culture can collapse.' But I have just the opposite reaction; I take hope from the fact that the downfall of the Chacoan Anasazi didn't have to happen. Given the problems they faced, they *could* have made other choices—ones that would have given their culture greater viability. Similarly, *we* don't have to make bad choices. We can make choices that will not exacerbate or accelerate the problems we face."

The ghosts look on, wondering whether we will be wiser than they were. ■

One of this year's most intriguing Westinghouse projects concerned computer learning. Sixteen-year-old Joseph Turian reflects upon the journey that brought him to the Westinghouse finals, and will take him ... who knows where.

A Portrait of the Programmer as a Young Man

by Joseph Turian

Thinking computers. Forty years ago, experts speculated that computers would possess human-like intelligence by the early '60s. In *2001: A Space Odyssey*, Dr. Chandra birthed HAL in the early '90s. And according to *The Terminator*, the military's defense system became self-aware and destroyed the Northern Hemisphere in 1997. According to the technophobes' predictions of our self-annihilation, I guess we're a little behind schedule.

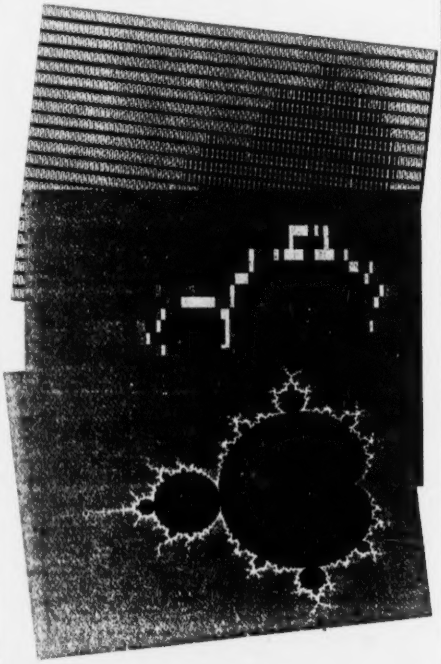
It seems inevitable to me that computers will some day be able to simulate human intelligence. Unlike the doomsayers, however, I believe this capability will *benefit* humanity. I want to be part of the process, helping to conceptualize, develop, and implement the required algorithms. With my Westinghouse project, *Automated Feature Selection to Maximize Learning in Artificial Intelligence*, I have made what I hope will be only my first contribution to that great endeavor.

For nearly as long as I can remember, computers have shaped and enriched my life. At four, I learned to read and write by playing text-based adventure games like Sierra's King's Quest. Weaned as I was on strategy and math computer games, it was only logical that I would enjoy programming. While my friends played Nintendo, I mastered Pascal.

Programming has given my creativity room to roam, a vast uncharted land to explore. Even as a child, I had a seemingly insatiable curiosity to pursue programming challenges wherever they led, honing my skills while having fun. I once spent two months consuming obscure, low-level DOS documentation about my PC's clock chip and 8086 assembly language, just so I could make the computer clock run backwards. Indeed, programming has been my passkey into an enchanted world where time no longer seems to matter because I am fully engrossed in what I'm doing.

My Fractal Phase

Seeing the results of my labors leap to life on the screen is, for me, one of the great pleasures of programming. Graphics, in particular, seem to speak to some deep mainspring in me, much as gunpowder or steel speak to some men. When I was 13, I became entranced by fractals, those filigreed shapes generated by iterative mathematical functions. A fractal may look simple, but when you zoom in on it, you find that it's made up of a multitude of mini-fractals. No matter how deeply you look, another, smaller fractal pattern is hiding somewhere within.



Reading *Chaos*, James Gleick's best-selling book on chaos theory, I was amazed to discover that the Mandelbrot set—the most famous of all fractals—could be generated fairly easily on a PC. I ran to my computer and whipped up a small program to draw the Mandelbrot set using the characters *1* and *0*. Knowing what it was supposed to look like, I was thrilled to see the *1*s outlining a Mandelbrot image.

Far from satisfying my hunger, this success only whetted my aesthetic appetite. Next I enhanced my rudimentary program so that, instead of outputting *1*s and *0*s, it would draw colorful ANSI boxes. The Mandelbrot set now appeared in color—but the image was limited to 80x25. To improve the resolution, I dug up my Turbo C++ documentation and read the chapter on the Borland Graphics Interface (BGI). I harnessed the capabilities of my VGA card and used the BGI to display the Mandelbrot set at the awe-inspiring resolution of 640x480, pushing my monitor to its limits.

Even then, I still wasn't satisfied; the program ran too slowly for impatient me. So I went back to code and optimized it. Seeing how large the graphics files were, I realized I would soon run out of space on my 80-meg hard drive. Data compression—a term then unknown to me—was sorely needed. Unaware of research already done in the field of data compression, I developed variants of run-length encoding, vector compression, wavelet compression, and fractal compression. (Imagine my surprise when I later discovered that the data compression techniques I had developed were in use in the computer world under such names as PCX, PostScript (PS), and YUVPak.)

From Fractals to Fairy Tales

Two years ago, ready to explore a different facet of computer science, I took a course in artificial intelligence (AI) at nearby Hofstra University. For one of my projects, I set myself a challenge: to write a program that could generate a story line plausible as a fairy tale.

Even though fairy tales have arisen in different cultures all over the world, they tend to have a common symbolic landscape, with oft-used plot and character elements: the journey that must be undertaken, the enchanted forest, the wise guide, the opponent with supernatural powers. These recurrent features are what make fairy tales amenable to being modeled using AI. Drawing upon insights from Vladimir Propp's classic treatise, *The Morphology of Fairy Tales*, I wrote a program that generated basic plot lines, the bare bones of fairy tales.

That success was an important step for me. Previously, I had participated in AI only as a spectator, viewing it as an arcane art practiced by wizards and gurus with super-Ph.D.s. This project proved to me that I, too, could create *thinking* programs.

. . . to Feature Analysis

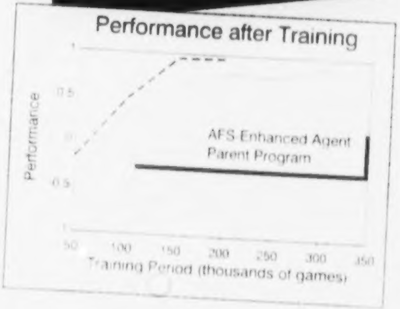
I got my chance to work on a real thinking program just a few months later, as an intern at the Research Science Institute. There I joined forces with Gregory Galperin, a graduate student at the world-renowned MIT AI Lab, on a project to enhance the learning ability of a computer game-playing program. This work became the basis of my Westinghouse submission.

Computer learning is an important problem in AI. Most real-world tasks are too complex to be solved by "brute force," that is, by evaluating the outcome of every possible action—something computers are very good at. To be useful to us in real-world tasks, computers will have to be capable of more intelligent problem-solving approaches, and that will require that they be able to learn.

Galperin had chosen to create a backgammon-learning AI program or "agent." Games are paradigms for real-world problems, but with fewer variables. Working with a game-playing agent allowed us to focus on analyzing a program's ability to learn, to become more expert. Backgammon was chosen because it's too complex for brute force solutions. To perform a two-move-deep analysis in chess, an AI agent must analyze approximately 50,000 moves—a feasible task with today's computers. To perform a comparable analysis in backgammon, an AI agent would have to examine 25.6 billion positions—clearly *not* feasible. Thus backgammon demands elegant solutions, paralleling real-world tasks.

Several sophisticated game-playing programs have already been written. Gerald Tesauro developed a backgammon-playing AI agent, called TD-Gammon, that is ranked among the top 20 backgammon players—human or machine—in the world. Game-playing AI agents play at levels anywhere from beginner to expert, but to the frustration of their creators, they all reach sub-optimal performance plateaus beyond which they no longer improve.

Galperin and I thought we could improve a game-playing agent based on TD-Gammon by making its learning process more closely mimic the way humans learn: by synthesizing discrete bits of data into recognizable patterns. We don't, for example, see pointillist art as mere dots. Rather, we mentally synthesize the points into the painting's salient features. By identifying important features and discarding superfluous data, we are performing *feature selection*. If computers could do the same, they should be able to learn more intelligently and more quickly.



Some AI agents have employed what might be called *feature recognition*: they could recognize pre-specified features they encountered. But those features had all been defined first by the programmers; the actual feature *selection* process was performed by humans, not the agent. In addition, the pre-selected features were typically "domain-specific." TD-Gammon, for example, includes a library of handcrafted backgammon features defined by Tesauro, an accomplished backgammon player. While previous agents have *recognized* features, none has been able to *generate* or define features for itself.

We wanted our AI agent to be able to create its own features, making handcrafted features unnecessary. My task was to write the part of the program that would enable the computer to identify features. By including a neural network layer in the program, I developed an algorithm that successfully performs ***automated feature selection*** (AFS): it generates its own features without human intervention or preprogramming. Once the program is started, the agent is an independent entity, using learning methods that can be applied to any comparable learning system.

As we had hoped, our program was an improvement over previous computer learning systems. The AFS-enhanced backgammon agent learned more quickly than the parent program *and* surpassed the parent's performance plateau. In fact, after long training, the AFS agent performed at a near-optimal level.

The most exciting thing about AFS is that it's not just a backgammon-learning program; it can be used to enhance the performance of virtually any computer learning system. This work suggests that it may be possible to maximize computer intelligence without having to pre-load an AI agent with an extensive library of domain-specific, handcrafted features—an important step forward in creating thinking machines.

Reflections

My work on automated feature selection has brought a strange symmetry to my life. Twelve years ago, a computer program helped me learn. Now, I have developed a way to help computers become better learners.

Many people spend their lives seeking something they love and can do well. I have found my grail. With wide-ranging powers inscribed into simple bits, computer programming will afford me enough challenge to last two lifetimes. ■

Besides wearing purple Polo pants, **Joseph Turian** *also enjoys playing the guitar, composing music, singing, and kickboxing with his best friends. He plans to continue his study of computer science, mathematics, music and philosophy at Harvard. He hopes someday to have a girlfriend.*

For more about Joseph's research, visit:
www.ai.mit.edu/people/jude/research/

EXPLORING CAREER OPTIONS: ART HISTORY AND ANTHROPOLOGY

Interview with Frederick Lamp, Curator

by Lesley Mackay

Dr. Frederick Lamp has been Curator of the Art of Africa, the Americas, and Oceania at the Baltimore Museum of Art for fifteen years. Holding a Ph.D. in art history from Yale University, Dr. Lamp combines a traditional academic background with a passion for overseas fieldwork.

How would you define your profession?

I'm an art historian, but a lot of what I do could be described as anthropology. In my work, I try to increase international awareness about the people who have produced art. While I am interested in art objects for themselves, I tend not to focus on their formal qualities. Instead, I approach them as a tremendous resource for exploring the cultural systems, ideas, and perceptions that led to their creation.

Have you learned a great deal with this cultural approach?

More than I ever dreamed. For example, my current exhibit of the art of the Baga people of Guinea, Africa, reflects a key insight into that culture: the Baga believe that they generate spirits by using masks, headdresses, and other artistic objects in dances and rituals. Baga people have expressed this view to me many times, and I have often discussed it with others in my field. The Baga are unusual in their confidence that the ceremonial use of their art literally creates a spiritual world.

How do you go about gaining that kind of subtle insight into a culture?

To enter into another culture, you need an attitude of great respect. To understand people whose lives are different from your own, you must share their daily life. In my fieldwork, I try to immerse myself in the culture I am learning about. I live with local residents, eat with them, and speak their language to the best of my ability.

I first went to Africa as a Peace Corps volunteer after receiving my undergraduate degree. I lived and worked as a teacher in a village in Sierra Leone, where I learned the Temne language, which is related to the Baga language. The Peace Corps challenges you to thrive in an unknown environment, an experience that can be both disconcerting and tremendously rewarding. My two years as a volunteer were among the happiest of my life and formed a basis for my later experience.

When did you discover that you were interested in art?

As a child, I had a gift for studio art; in fact, a painting of mine was hung in a student show in the Philadelphia Museum of Art when I was in the first grade. My interest in studio art has not diminished, but over time I have channeled my own creativity into photography and film making. These arts are very important to my fieldwork and to the exhibitions I create. I also do a great deal of drawing, both for my own records and to illustrate articles.

When did you discover that you were interested in Africa?

My childhood enthusiasm for art was matched by a strong interest in Africa. I think this grew out of a curiosity about African American culture. I may have been attracted to that culture partly because of my own unconventional background as a member of a Mennonite community in rural Pennsylvania. To begin with, I may have felt some empathy toward African Americans because we, too, were alienated from the mainstream. In addition, I admired the exuberance of African American music and art in contrast to the austere reserve of the Mennonites.

When I was very young, both art and Africa seemed alluringly mysterious to me. As it turned out, African art *was* largely a mystery outside Africa: while prominent artists such as Picasso had brought African influences into Western art, little was known on other continents about Africa's artistic traditions and their diverse purposes. When I began my graduate work, scholars were just beginning to ask questions about African art, to go beyond connoisseurship, the simple focus on art objects and their properties.

Art history benefitted from the international perspective that sprang up in U.S. culture during the 1960s and '70s. During that time, many were beginning to question the absolute authority of our mostly European civilization and to wonder about the truths of other cultures. This climate nurtured the work of those of us with an interest in faraway places and peoples.

Did you aspire to be an African art historian during your years as a student?

I didn't articulate that goal until the end of my graduate career, when I was entering my thirties. It took me a long time to realize that my passions for Africa and art could be integrated into a career.

After receiving a bachelor's degree in art education, I obtained master's degrees in both African studies and art history before going to Yale to pursue my Ph.D. During my eleven years as a graduate student, I took time off to teach art in the public schools. During that period, I thought that a teaching career in the United States might be my ultimate destination. Fortunately, I was able to go back to Sierra Leone once I began work on my dissertation, which was about the use of art to express the passing of time in Temne rituals. That helped clarify what I really wanted: a career that would allow me to work in Africa.

Do you view fieldwork as the basis of your career?

I do. My work in the United States centers on organizing my data and contributing to the life of the museum. I also struggle to find time to conduct research, to review my thousands of photographs of art objects, to try to establish patterns of similarities among objects, and to read the work of my colleagues. But for me the really illuminating work takes place in the field. That work is also, I think, intrinsically more moving because of the tremendous privilege of living in another culture and of coming to know people there.

How do you create an exhibition of a culture's sacred objects without objectifying the culture?

By bringing a culture's ceremony, dance, oral narratives, philosophy, and history right into the heart of the presentation. For example, at the current Baga exhibit, visitors hear music from and watch videos of dances and other ceremonies as they move among the art objects. The videos present the uses of the objects, which endows them with their proper meaning. Wall panels and lengthier writings related to an exhibit are also critical for conveying historical and cultural and philosophical background.

Many non-Africans fall into the misconception that African societies are timeless and unchanging. One of my biggest goals in mounting the Baga exhibit was to show how much upheaval and oppression the culture has survived and how much it has changed in the last hundred years.

Besides fieldwork, academic research, and exhibitions, what else does your work involve?

Cultivating and maintaining relationships with collectors and other museums. I once received a grant to visit the museums and great private collections of African art in Europe. Recently, many of those collectors and institutions agreed to lend their works to the current exhibit of Baga art at the Baltimore Museum of Art.

Do you collect when you are out in the field?

No. Although I respect collecting and am a collector, both privately and for the museum, I do not collect when I am out in the field. Art collecting can be voracious, and it's fair to say that in the past this activity has damaged Africa by taking so much out of it.

If I bought objects while living overseas, I could easily disrupt local art production. For example, the approach taken by Baga carvers could change if they knew that they were carving for me. They might abandon creating for their own aesthetic and ritual purposes, or adopt different means and styles of production. I don't want to end up undermining the very culture that I have come to study.

It sounds as though a person in your profession has to be extremely sensitive. What other personal qualities are needed in order to conduct overseas fieldwork in art history and then to translate that work into the life of a museum?

I think it takes courage to enter fully into the life of a culture very different from your own. You do take physical risks, for example, in routine travels. You may also be caught up in the consequences of political conflict. I think that good fieldworkers end up becoming advocates for the cultures they enter, and a commitment to advocacy can make you vulnerable in a conflict situation.

Female Dance Headdress, Guinea, Africa (wood and metal)

Courtesy of The Baltimore Museum of Art: Gift of Alan and Janet Wurtzburger (BMA 1957.97)

Beyond courage, a developed capacity for respect and empathy are critical, as well as more targeted abilities, like the ability to learn a foreign language. And for the stateside work, good communications skills and a high degree of organization.

What's the outlook for museum-based careers in art history?

Currently, very few positions are available in museums for curators, but economic growth in the U.S. should benefit our museums and might lead to the opening up of more positions. In addition, many museums are taking on more responsibility for outreach and education within their communities, creating a need for more staff.

Both inside and outside museums, people are more interested in Africa now than ever before. Such community interest often leads to institutional growth. Opportunities for those with expertise related to other continents also exist in many fields: anthropology, teaching, work with non-governmental organizations, governments, and industry.

For every generation, new circumstances both create and limit opportunity. Young people interested in a career like mine should pursue a Ph.D. in art history or anthropology, should conduct fieldwork, should learn languages. But they will have to be resourceful about maximizing opportunity.

I believe that the best way to prepare for a career like mine may be *not* to plan a career too early. For ten years I immersed myself in the things I loved; then I decided what I wanted to do. It was sometimes painful not to have clear goals, but I believe that the intense fermentation of ideas that I allowed myself was very important. Painting, joining the Peace Corps, returning to Africa, and thinking about art were the things that were important for me.

I don't think that searching for your own mix of interests can or should be avoided, even by young people dealing with today's pressures. Follow your passion. At the same time, search for ways that you can use that passion both to serve society and to create a career niche for yourself. ■

Selected Resources

Frederick Lamp. (1996). *Art of the Baga: A drama of cultural reinvention.* The Museum for African Art: New York.

For information, call The Museum for African Art at (212) 966-1313 or fax (212) 966-1432.

FASCINATING CLASSICS

CRY, THE BELOVED COUNTRY

by Alan Paton

Review by
Lesley Mackay & Kimberly Nolan

Kimberly: So many friends and colleagues have recommended *Cry, the Beloved Country* to me, I have wanted to read it for years. With its powerful, poetic style and riveting story, this novel by Alan Paton, first published in 1948, more than fulfilled my expectations. Paton's "beloved country" is South Africa, a nation that has suffered from intense racial divisiveness and oppression. His story of racism and its threat to human values is still relevant today.

The narrative centers around the fragmentation of a black family. The Kumalos endure losses that mirror a larger one: the disintegration of traditional South Africa as blacks move by the thousands from rural homesteads to cities. The tribal way of life has broken down, and as a result, few are left to work the land or to bring new ideas and life into the traditional communities.

Lesley: A terrible sadness pervades this book, doesn't it, Kimberly? It is present not just in Paton's depiction of social conflict and upheaval but also in his evocation of the wasting of the South African land. Paton begins his novel with a description of his homeland in its original state:

> *The grass is rich and matted, you cannot see the soil. It holds the rain and the mist, and they seep into the ground, feeding the streams in every kloof. It is well-tended, and not too many cattle feed upon it; not too many fires burn it, laying bare the soil. Stand unshod upon it, for the ground is holy, being even as it came from the Creator. Keep it, guard it, care for it, for it keeps men, guards men, cares for men.*

This early passage suggests the sacred qualities of the land and links the fate of the land to the fate of the people. Paton maintains the idea of this shared destiny throughout the novel.

Kimberly: What exactly is wrong with the South African soil? Paton doesn't offer a purely scientific explanation; the connection is metaphorical: the land no longer feeds or spiritually nurtures the people who live on it. This change fuels the depopulation of the rural communities:

> *Down in the valleys women scratch the soil that is left and the maize hardly reaches the height of a man. They are valleys of old men and old women, of mothers and children. The men are away, the young men and the girls are away. The soil cannot keep them anymore.*

And yet, despite the threats to both land and community, this novel does not suggest that South Africa is doomed. Rather, *Cry, the Beloved Country* explores the possibilities of cultural and personal renewal after life based on a rich relationship with the land has broken down.

Lesley: Paton examines the prospects of survival and growth—in spite of traumatic change—through the experiences of his protagonist, Stephen Kumalo, a distinguished black Anglican priest who ministers to a small traditional community in the veldt. The novel is structured around a trip Reverend Kumalo makes from his country home to Johannesburg and back again.

The journey changes Kumalo's life. First, he discovers shattering truths about his brother, his sister, and, especially, his son, all of whom have moved to Johannesburg and have stopped communicating with their family back home. Second, he identifies new danger and alienation in the city—influences that he knows may eventually affect all of South Africa and its people.

Kimberly: Paton depicts Johannesburg as a national crucible, a place of conflict and trial for all South Africans:

> *All roads lead to Johannesburg. If you are white or if you are black, they lead to Johannesburg. If the crops fail, there is work in Johannesburg. If there are taxes to be paid, there is work in Johannesburg. If the farm is too small to be divided further, some must go to Johannesburg. If there is a child to be born that must be delivered in secret, it can be delivered in Johannesburg.*

The city, like the countryside, becomes a powerful force in the novel, one with an undeniably corrupting power.

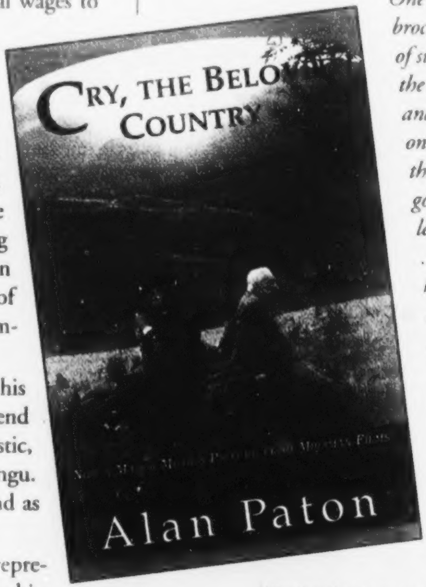
Lesley: Corrupting and soul-destroying. Paton depicts a truly detestable city. Through the eyes of Reverend Kumalo, he shows that life in Johannesburg is absurdly adversarial for blacks. Kumalo observes indecent housing and wages so low that even those with

South Africa: Beloved Country

The historical relationship between whites and blacks in South Africa is long and complex. In 1652, the Dutch East India Company created a settlement on the Cape of Good Hope. From this outpost, company workers and independent immigrants set out to establish a dominant presence as farmers, giving birth to the Afrikaner culture. As in so many other places in the world, struggles over fertile land brought the native and immigrant cultures into terrible, centuries-long dispute. The land suffered horribly, along with the people.

In 1948, the same year that *Cry, the Beloved Country* was published, South Africa mandated into law the racist social system known as apartheid. Using draconian measures intended to consolidate white privilege and wealth, an elaborate legal structure upheld strict racial separation in all areas of life: institutions, residential patterns, politics—even relationships. For example, apartheid halted the native urban migration that Paton describes in the novel. Africans were channeled into non-urban "homelands." Even blacks whose labor was needed jobs can starve. He sees the effects of a government that constantly undermines black hopes and the possibilities of black community. Even worse, he finds that, in the city, each person looks out for him- or herself: there is no extended family, no community of elders to turn to for advice, no shared sense of responsibility.

The crowds of new immigrants mostly seek employment in vast mines outside the city. Once small farmers who worked the land, they have become industrial hard laborers paid minimal wages to tear up the land and take out its riches. Paton presents the growing alienation of South African blacks from their own territorial inheritance as a central problem in his novel.



Kimberly: Forces that emanate from the white culture—industrialization, urbanization, and, especially, racial discrimination—bring about the changes in the novel. Nevertheless, Paton's story is didactic, presenting moral lessons for all. While showing the destruction caused by white South Africa, he explores the path of redemption through personal virtue. The novel recommends that path to everyone, regardless of race.

Lesley: Paton advocates for virtue largely through his depiction of admirable characters. The noble Reverend Kumalo is befriended in Johannesburg by another idealistic, generous, and humble black priest, Reverend Msimangu. These two dignified men forge a powerful personal bond as they encounter the city's demons together.

In the novel, they join forces with characters who represent the possibilities of change for the better within the white community. Arthur Jarvis, a young and fervent believer in racial justice, is killed in a robbery committed by black youths. His father, James Jarvis, meets Stephen Kumalo in the aftermath of this murder. James Jarvis had never understood his son's commitment to social change, but after his son dies, the older Jarvis begins to lament the racial divide in South Africa. Partly because of his growing admiration for Kumalo, he comes to a deeper respect and concern for the black community.

Kimberly: The murder of the young Arthur Jarvis serves as the crossroads of the novel, bringing together its key black and white characters. One of the book's cruelest ironies is that the white murder victim is an anti-racist writer and founder of the African Boys Club of Johannesburg. The young black man who kills him during a robbery is utterly removed from Jarvis's social sphere and unaware of his victim's commitment to the black community. He shoots Arthur Jarvis not out of anger or hatred but out of fear, an emotional theme that pervades the novel.

Lesley: This fear reverberates from the terrible division between the races, maintained by the white community's ignorance of the black experience and of the larger reality of their own society. Arthur Jarvis laments this ignorance in writings his father later discovers. As Arthur puts it, even in respectable families, whites grow up ill equipped to deal with, or even recognize, the true South Africa:

> *One can read, as I read when I was a boy, the brochures about lovely South Africa, that land of sun and beauty sheltered from the storms of the world, and feel pride in it and love for it, and yet know nothing about it at all. It is only as one grows up that one learns that there are other things here than the sun and gold and oranges. It is only then that one learns of the hates and fear of our country. … I was born on a farm, brought up by honourable parents, given all that a child could need or desire. They were upright and kind and law-abiding; they taught me my prayers and took me regularly to church; they had no trouble with servants and my father was never short of labour. From them I learned all that a child should learn of honour and charity and generosity. But of South Africa I learned nothing at all.*

Kimberly: James Jarvis feels wounded when he reads his son's criticism of the benevolent, yet complacent, atmosphere in which he was raised. The father's growth occurs when he is able to accept this reproach and forgive those involved in his son's murder.

Finally, Jarvis takes on the role of a peacemaker and community builder, linking the disparate elements of South African society. Like the ministers Kumalo and Msimmangu, and like his own son, he comes to identify a core of fear that threatens to rot the nation. I think Paton makes clear that such fear cannot be endured.

Lesley: Facing that fear and transforming it into tolerance and understanding is the only way to heal any "beloved country." ■

__Kimberly Nolan__ is an Assistant Coordinator of CTY Academic Programs at IAAY. She also teaches literature and women's studies at the University of Baltimore. __Lesley Mackay__ is IAAY's staff writer.

in cities had to carry passes that allowed them to enter during the day, but forbade them to stay overnight. The living arrangements, livelihoods, and activities of blacks were subject to the approval of a state that was openly dedicated to their disenfranchisement.

South Africa endured apartheid for less than 50 years. In 1994, following years of protests within the country and around the world, apartheid and the political party that upheld it were defeated at the polls. The newly elected democratic government articulated a commitment to racial justice. The task of combatting the fear and ignorance that Paton eloquently depicts could truly begin.

Announcing the 1997–98 series:

☛ T.H. White, *The Once and Future King*
Willa Cather, *My Ántonia*
John Steinbeck, *The Grapes of Wrath*
Virginia Woolf, *To the Lighthouse*
Ernest Hemingway, *The Old Man and the Sea*

THE COACH'S CORNER

by Chengde Feng

__Mr. Feng__ teaches mathematics at the Oklahoma School of Science and Mathematics (OSSM) and has coached many students who have competed successfully in mathematics contests in China and the U.S. In this column, Mr. Feng offers Imagine *readers questions designed to improve their problem-solving skills.*

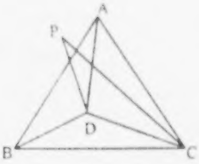
SOLUTIONS TO THE MATH PROBLEMS FROM THE MARCH/APRIL ISSUE

Let $u = \frac{x}{a}$, $v = \frac{y}{b}$, and $w = \frac{z}{c}$. Then $u + v + w = 1$ and $\frac{1}{u} + \frac{1}{v} + \frac{1}{w} = 0$.

$$\frac{1}{u} + \frac{1}{v} + \frac{1}{w} = 0 \Rightarrow \frac{vw + wu + uv}{uvw} = 0 \Rightarrow uv + vw + wu = 0.$$

$$u + v + w = 1 \Rightarrow (u + v + w)^2 = 1 \Rightarrow u^2 + v^2 + w^2 + 2(uv + vw + wu) = 1 \Rightarrow u^2 + v^2 + w^2 = 1$$

Thus $\frac{x^2}{a^2} + \frac{y^2}{b^2} + \frac{z^2}{c^2} = 1$



Draw BD.
$\Delta DPC \cong \Delta DBC$ (SAS) $\Rightarrow m\angle P = m\angle DBC$.
$\Delta DBC \cong \Delta DBA$ (SSS) $\Rightarrow m\angle DBC = m\angle DBA$.
$\Rightarrow m\angle DBC = \frac{1}{2} m\angle ABC = 30°$.
Therefore $m\angle P = 30°$.

Suppose that $m^2 + m + 7 = n^2$, where n is a positive integer.
$\Rightarrow 4m^2 + 4m + 28 = (2n)^2 \Rightarrow (2m + 1)^2 + 27 = (2n)^2 \Rightarrow (2n + 2m + 1)(2n - 2m - 1) = 27$

$$\Rightarrow \begin{cases} 2n + 2m + 1 = \pm 1 \\ 2n - 2m - 1 = \pm 27 \end{cases} \text{or} \begin{cases} 2n + 2m + 1 = \pm 27 \\ 2n - 2m - 1 = \pm 1 \end{cases} \text{or} \begin{cases} 2n + 2m + 1 = \pm 3 \\ 2n - 2m - 1 = \pm 9 \end{cases} \text{or} \begin{cases} 2n + 2m + 1 = \pm 9 \\ 2n - 2m - 1 = \pm 3 \end{cases}$$

Solving these systems of linear equations for integer m, it yields $m = -7, 6, -2$, and 1.

Consider the games played by Team A.

Case 1: A played the first game of the tournament and lost the last game.

Case 2: A played the first game, and either didn't play the last game or won the last game.

Case 3: A didn't play the first game (B and C did), and lost the last game.

Case 4: A didn't play the first game, and either didn't play the last game or won the last game.

Suppose that Team A lost x games. Since each game except the last game lost by A contributed two games won by Team B or Team C, and the last game lost by A (if A did play) contributed only one game won by B or C, we may set up equations for x in each of the above cases as follows.

Case 1: $2(x - 1) + 1 = 12 + 14$, no integer solution for x.

Case 2: $2x = 12 + 14 \Rightarrow x = 13$.

Case 3: $1 + 2(x - 1) + 1 = 12 + 14 \Rightarrow x = 13$.

Case 4: $1 + 2x = 12 + 14$, no integer solution for x.

Consequently, Team A played 10 + 13 = 23 games. Similarly, the number of games lost by Team B is 12, and by Team C is 11. Thus B and C played 24 and 25 games, respectively.

Suppose that the five cities are numbered 1 through 5. For each student we use a five-digit number to describe his/her journey by writing 1 on the ith digit if the city number i was visited and 0 if it was not visited for $i = 1, 2, 3, 4, 5$. Since each student went to at least one city but no more than two cities, there are total ${}_5C_1 + {}_5C_2 = 15$ different cases.

Think of these 15 five-digit numbers as 15 pigeon holes. Applying the *Pigeon Hole Principle*, there are at least

$\left[\frac{1997}{15}\right] + 1 = 134$ students who visited the same city/cities.

Doing Your College Search on the Internet

by Linda E. Brody, Ed.D.

Thinking about college applications, but feeling overwhelmed by the seemingly endless number of colleges that warrant your consideration? Fortunately, you can now make your college search easier by using Internet resources.

Getting to Know a College

A college's Web site typically provides information on the admissions process, course descriptions, a faculty list, and much more—sometimes even photos of the campus. You may be able to order catalogues online or communicate directly with an admissions officer or faculty member. Web sites are updated and expanded regularly, so be sure to revisit the sites of your favorite choices often.

You can access any site on the World Wide Web by typing in its "address," the Uniform Resource Locator (URL). For college homepages, the URL includes the name or abbreviation of the college: for example:

www.JHU.edu
www.Yale.edu

If you don't know the URL, try guessing. If that doesn't work, enter the name of the college into a search engine such as AltaVista, which will call up all sites in its database that mention the name.

If you're looking at several schools, it's faster to use a directory of colleges. These are just two of many sites that provide such directories:

www.clas.ufl.edu/CLAS/american-universities.html
www.mit.edu:8001/people/cdemello/univ.html

Using College Search Programs and Rankings

What if you have no idea which colleges to consider? Programs on the Internet can help identify appropriate choices for you.

A college search program allows you to specify characteristics that are important to you (e.g., size of school, public or private, geographic location). The program will then scan its database to generate a list of institutions that meet your specifications. Be a bit cautious about using the results as your final list. A particular search program may not include some features that are extremely important to you, and its database may not include all possible colleges. But such a tool can get you started; for example:

www.collegeboard.org
www.petersons.com

Rankings and evaluations of colleges for academic quality and other criteria can also be found on the Web. To judge their validity, you'll need to consider who was surveyed, but positive evaluations or high rankings may encourage you to consider some colleges that you might otherwise have overlooked. For example, see the rankings by U.S. News and World Report:

www.usnews.com/usnews/edu/home.htm

Considering College Entrance Examinations

Do you have questions about standardized tests? It's likely you can find the answers on the Web. You can even register online to take the SAT by accessing **www.collegeboard.org**, The College Board's Web page. ACT's page at **www.act.org** is under development.

Gathering Financial Aid Information

Are you worried about paying for college? The Web offers a vast amount of information about financial aid, scholarships, and fellowships. Using a search engine, you can type in "scholarships" or "fellowships" and call up a long list of relevant sites.

Two particularly good sources of scholarship information are **www.finaid.org**, a site sponsored by the National Association of Student Financial Aid Administrators, and **www.tgslc.org**, a site sponsored by the Texas Guaranteed Loan Corporation.

Some sites offer customized searches that comb their databases for scholarships for which you qualify for consideration. These include **www.finaid.org**, mentioned above, and **www.collegeboard.org**, The College Board's site.

You can even submit a federal financial aid application (FAFSA) online. See **www.ed.gov/prog_info/SFA/FAFSA/** for information and forms.

Applying Online

If you're used to the ease of editing on a computer, you may be frustrated by having to fill out a long application form on a typewriter. Many colleges now allow you to submit applications online.

Check an individual college's homepage to see whether its application is included. Certain Web sites provide this service for a variety of colleges; for example:

www.collegeboard.org
www.collegescape.com/apply/apply.html

College applications are also available on PC software. To order a free CD Rom with applications to over 500 U.S. colleges and universities, see Apply '98's Web site: **www.weapply.com**

Moving from Web Sites to On-site Visits

Once you've started using the Web, you can follow the links from page to page to access additional sites full of useful information about colleges and the admissions process.

After you've identified colleges that offer the programs and environment you're seeking, don't stop there. Plan campus visits to view these colleges personally. It's important to tour the campus, meet students, talk to faculty and admissions staff, and sit in on classes. And these visits will be even more worthwhile if you go prepared with information that you've found on the Web.

For more information, see the **Internet Guide for College Bound Students**, *by Kenneth E. Hartman (The College Board, 1996).*

STUDENTS REVIEW

UNIVERSITY OF PENNSYLVANIA

College Review Series

This on-going series is intended to aid prospective college students in their search by offering insiders' views of selected colleges and universities, as expressed by current undergraduates or recent graduates who have high academic ability. Note that the number of reviewers is small. Consider their personal perspectives as only one component while you gather factual information and impressions from such other sources as college catalogues, site visits, talks with officials and students on campus, and the advice of your guidance counselor and teachers.

University of Pennsylvania

Our reviewers include eighteen students, who major(ed) in accounting (1), anthropology (1), biological basis of behavior (1), cognitive science (1), computer science (2), East Asian studies (1), economics (1), electrical engineering (2), English (2), entrepreneurial management (1), finance (1), French (1), history (1), information systems (1), marketing (1), math (3), philosophy (1), psychology (1), and sociology (1). (The number of majors exceeds eighteen because several students are pursuing dual degrees.) Students' comments appear within quotation marks.

Quality of Academic Instruction for Undergraduates

Penn offers both a liberal arts education at the College of Arts & Sciences (CAS) and a technical education at the School of Engineering & Applied Sciences (SEAS). In addition, its Wharton School has the #1-ranked undergraduate business program in the country, as well as several unusual dual-degree options: **Management & Technology** (M&T), in which students complete a B.S. in Economics at Wharton and either a Bachelor of Applied Science (a four-year option) or a B.S. in Engineering (a five-year option) at SEAS; and **International Studies & Business**, a four-year program in which students complete a B.S. in Economics at Wharton and a B.A. in International Studies at CAS.

"While Penn is justly famous for its graduate schools, its undergraduate programs are really quite excellent. I felt I received a terrific education there. Except for intro courses, class sizes tend to be small. Entering with AP credits and/or summer courses, a student can attend some classes with fewer than 25 students from freshman year on."

"I was delighted with the education I received at Penn. The overall quality of instruction is excellent (although I had my share of truly awful profs—you really should shop around for the good profs and courses). It ***is*** *a big school; you need a certain amount of motivation and confidence to get things accomplished in the bureaucracy."*

"Wharton, with its integrated business and liberal arts curriculum, is the most competitive and in many ways the most challenging school at Penn. Some of my courses there were darned near impossible (although my history classes at the college were not exactly a cakewalk, either). The dual-degree programs offer a unique undergraduate education, and completing them is feasible if you have enough AP credits or advanced standing. I was able to earn two degrees in four years without ever having to take more than five courses in a semester."

"The core curriculum at Wharton is very strong, with classes ranging from Accounting 101 to Operations & Information Management to Legal Studies. Everyone at Wharton is required to take the same core business courses, but there is freedom of choice in both business and liberal arts distribution electives. I liked the fact that, all four years, my business education was balanced with liberal arts courses at the college. Wharton is unbeatable in business education. To top it off, its career counseling and job hunting resources are vast. Just about everyone I know from Wharton has had very little trouble finding jobs (well-paid, too!)."

"SEAS has an excellent advising system and mostly small classes. It's a very good program if you're sure you're interested in engineering. I really appreciated the curricular flexibility in the computer science and engineering program. And M&T allows you to receive a rigorous technical education while completing a full degree in a very different field: business."

"My first year at Penn, the intro classes were large and impersonal, and I felt my professors didn't care if I succeeded. I was disappointed in the quality of instruction, so much so that I arranged to spend my junior year at a small liberal arts college. However, when I returned to Penn as a senior, I realized how much a research university has to offer talented upperclassmen. I had small classes with topnotch researchers. My professors invited me to graduate-level colloquia, and I even took several graduate courses. I did all this while my friends at the small college struggled just to find enough classes to meet their major requirements."

Social Life

In addition to Penn's wide range of on-campus social opportunities, Philadelphia's center city is just blocks away.

"Penn has a great social life, better than that at any other equally academically reputable school. There are ***many*** *activities to become involved in. I worked at the college radio station, wrote for the humor magazine and the school paper, and participated in several academic and debate clubs. And being in Philadelphia is a major social plus. Philly is a* ***great*** *town, with a world-class art museum, world-class symphony orchestra (with its gorgeous home, the Philadelphia Academy of Music), fabulous restaurants, and all major sports."*

"Penn has something for everyone; the diverse student body allows each student to find a niche. Campus social life centers around Greek organizations, but I never felt as though Greek affiliation was a necessary condition of an active social life. Penn also tries to keep its students happy by maintaining great facilities like the library, dining halls, and study lounges."

"Penn is a fairly large school—much larger than I realized when I chose it. With the vast number of clubs and organizations, it's very easy to get involved. Activities range from a cappella groups to intramural and intercollegiate sports to Wharton Women to Students for Asian Affairs to well, just about anything imaginable. Every

weekend there are plenty of things to do: frat parties, dances, concerts by visiting artists, student-produced shows. And if you get bored with Penn, downtown Philly is only a few blocks away. Because of its urban location, Penn is not the safest campus around, but the school's efforts to guard students' safety are admirable. Shuttle bus escorts, walking escorts, and emergency telephones are some of the measures that help make the environment safer."

"The campus itself is very safe, but the reality of West Philadelphia a few blocks away is harsh. On the other hand, Center City—with shops, great restaurants, and the Philadelphia Orchestra—is also only blocks away."

"When looking at a school's social life, don't just look at the freshman experience; look at what the juniors and seniors are doing. While students at isolated campuses may be bored during their last two years, Penn students have all the entertainment resources of a large city."

What Do You Like Best about Penn?

Reviewers praised the high-quality academics, the motivated fellow students, and the strong interdisciplinary programs.

"Everyone I knew was committed to success, school, and life. There was no shortage of people with whom you could argue about what was covered in your economics class that week. Dinner conversations about current events could explode into heated political debates with the neighboring table."

"I've been very excited about the medical research opportunities available to undergrads. The Biological Basis of Behavior (an interdisciplinary major that includes biology, psychology, and medical anthropology) gives students the chance to pursue a wide range of research interests while completing premed requirements."

"The administration has creatively linked diverse strengths within the university to offer innovative interdisciplinary programs like the popular M&T dual degree. More recently, after discovering that 20% of Wharton graduates go to law school within five years of graduation, the university decided to offer a six-year B.S./J.D. option for students who want to pursue both a business and a law education. I really respect their continuing efforts to design programs to meet students' multifaceted interests."

"The anthropology department is incredible. Professors are great, and the museum is fabulous."

What Do You Like Least about Penn?

The stresses of urban life were the #1 complaint.

"The neighborhood west of the campus is a scary place. You really have to be careful. Common sense is the best defense."

"The city scene can get tiresome at times. I've also been disappointed with the domination of the social life by Greek and special interest groups. Penn has a wonderfully diverse student body, but the pressure to be politically correct has increased drastically in the last few years; it's gotten to the point that, no matter what you say, you have to worry about offending someone."

UNIVERSITY OF PENNSYLVANIA

Philadelphia, PA 19104
(215) 898-7507

- 4-year private coed university.
- Urban campus.
- Full-time undergraduate enrollment 1996–97: 4,766 men; 4,540 women.
- Special features: Dual-degree programs between Wharton and other schools within Penn, including Engineering & Applied Sciences, Arts & Sciences, Law, and Nursing (the last two beginning in 1997–98). One of the best anthropology and archaeology museums in the country.

Who Would Be Most Compatible with the Academic and Social Atmosphere at Penn?

"Someone who is bright, motivated, confident, and has a good work ethic. The academic structure is best suited to students who are somewhat career oriented but interested in a liberal arts background as well. Street smarts are helpful, but even if you don't have them before coming to Penn, you'll quickly learn."

"The prevailing attitude among Penn students—one promoted by the administration—is a fairly pre-professional one. Penn is an exceptional resource for motivated individuals, but those looking for a learning-for-its-own-sake intellectual environment might be disappointed."

"Diligent, independent, and self-motivated. If you know what you want, Penn offers you the opportunity to achieve your goals. If you don't yet know, many curricula are flexible enough that you don't have to choose a major until after freshman year in SEAS and even later in CAS."

"To succeed at Penn, you need to be an advocate for yourself. Just as in the adult world no one will remind you to pay your bills, here no one will warn you that you aren't going to meet your graduation requirements. It's an environment that really prepared me for adult life."

If You Had It to Do Over Again, Would You Go to Penn?

All said yes, a few with qualifications. Wharton students were especially enthusiastic.

"In a heartbeat. It's a great school, with solid traditions and history, excellent faculty, and a great student population, all in a wonderful city."

"Yes, I don't think any other school would have given me the same opportunities. And in addition to the resources available to undergrads, Penn has a wonderful alumni network. I have many friends who owe their careers (or at least the start of them) to fellow Penn grads."

"Yes. If there's any reason to come to Penn, it's Wharton. The education is topnotch, and the sky's the limit with a degree from Wharton. As a freshman, I thought of transferring—Penn's size and the city were getting to me—but now I can't picture myself anywhere else. It may take a while to adjust, but it's worth the effort."

"Even though Penn was not my first choice, I strongly believe it has been better for me than my other choices would have been. It may have less of an aura than the other Ivies, but its academics are on the same level. Furthermore, it is strongly grounded in the reality of everyday life and prepares you well for the world."

As you try to find the college or university best suited to you, the views of Penn presented above may be helpful. Keep in mind that these students might have had similar positive or negative experiences had they attended a different university. At any college, it is important to seek out challenging academic experiences and the best professors and to create a social life that fits your personal style. ■

Note. The students quoted in the College Review Series are expressing their own views, which are not necessarily those of JHU or IAAY.

CREATIVE MINDS
ImaGiNe...

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Alexander Saeed (17) holds a B.A. in Biology/Psychology and an M.A. in Psychology from The Johns Hopkins University. He is now engaged in software engineering with the Institute for Genomic Research.

MATHEMATICAL PROBLEM SOLVING TECHNIQUES

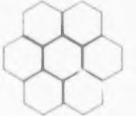
by Alexander Saeed

SOLUTION TO "IT'S MAGIC!" PROBLEMS IN OUR MARCH/APRIL ISSUE

Before trying the most challenging puzzle presented in the last issue, you were asked to warm up your problem-solving neurons by tackling two *Magic Squares* (4x4 and 5x5) and a *Magic Triangle* (9 chambers). If the sums of the numbers along each straight line are equal, then you know that you've discovered one of the multiple solutions to those shapes. A 4x4 Magic Square, for example, has 880(!) possible solutions.

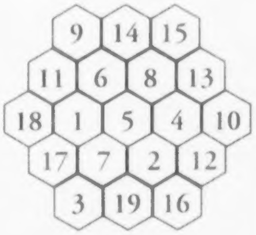
By contrast, there's only *one* possible *Magic Hexagon*, and its solution is unique. Amazing, but true! Out of the infinite options of hexagonal arrays with multiple layers, only a 19-chambered hexagon can be "magic," with all its rows adding up to the same number.

The smallest hexagon (7 chambers) cannot be magic because $(x+y)$ must equal $(x+z)$, which implies that $y = z$. Similarly, a hexagon with more than 19 chambers cannot be magic (unfortunately, we don't have the space to present the elegant proof that demonstrates this impossibility).



The Magic Hexagon was discovered by Clifford W. Adams, who worked as a clerk for the Reading Railroad Company. Unlike other problems presented in this column, the Magic Hexagon is one of those mathematical curiosities that can only be solved through sheer determination. After Adams conceived this problem, he made a set of hexagonal tiles and numbered them 1 through 19. He carried the tiles around with him and, whenever he had spare time, took them out and worked on the puzzle. This went on for 47 years.

One day, while he was in the hospital recovering from an operation, Adams found the solution. But when he left the hospital, the paper on which he had written his answer was lost. Undaunted, Adams tried again ... and again. Five years later, in December 1962, he found the paper with his original solution. And here it is, the unique answer to the Magic Hexagon.



SOLUTION TO "YES, ANOTHER PUZZLE" IN OUR MARCH/APRIL ISSUE

by Tim Boester

Fascinated by mazes and puzzles, ***Tim Boester*** *is also intrigued by roller coaster design. Tim is a junior at the University of Chicago, where he is studying physics and math.*